$4.00 per Year. AUGUST 25, 1910 Price 10 Cents

AUG 25 1910
PUBLIC LIBRARY

American Machinist

A Practical Journal of Machine Construction
Issued Weekly by the Hill Publishing Co., 505 Pearl St., New York

Vol. 33. Editorial Index Page 365 Advertising Index Page 67 No. 34

BECAUSE

"ARGUTO"

Cuts Out The Lubrication Problem

NO OIL OR GREASE FOR ARGUTO OILLESS BEARINGS

Have you ever considered the time it takes to oil and keep your loose pulleys in repair—consider how much you would save if they required attention once in

2504 DAYS

"Arguto" Did It—We Can Prove It

Oil and rapid running loose pulleys never stay long in company, and trouble follows the parting—mineral oils and animal belts being poor friends. "Arguto" prolongs the life of your belts from 40 to 50 per cent.

DON'T BE A SKEPTIC

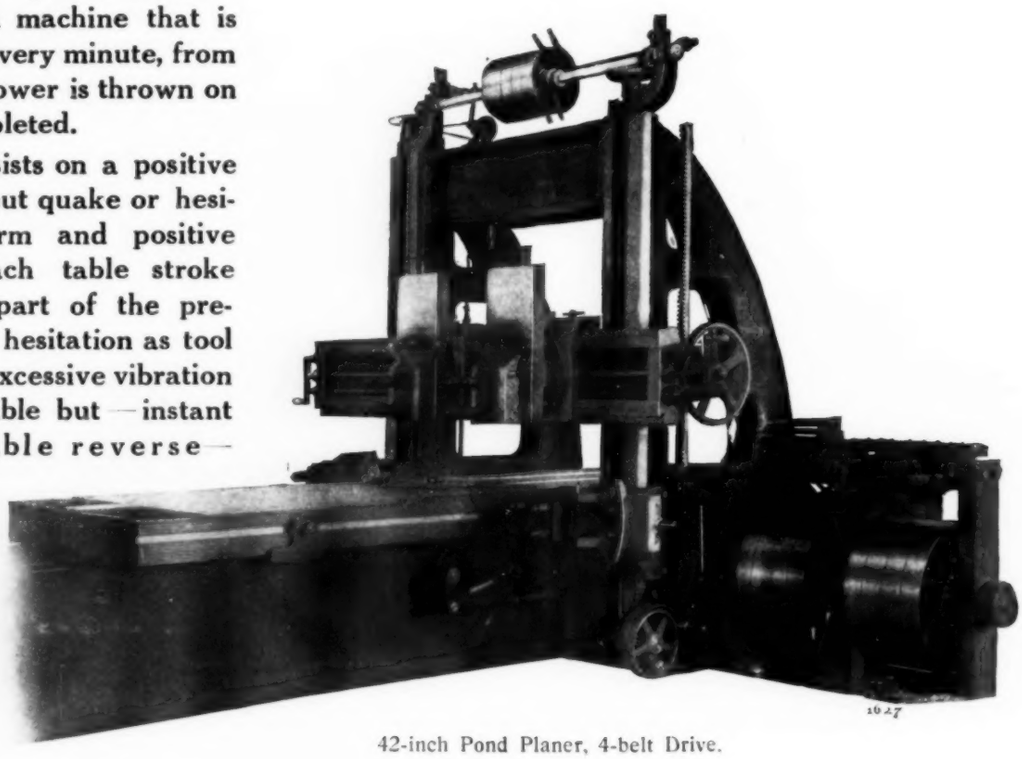
ARGUTO OILLESS BEARING CO. PHILADELPHIA, U. S. A.

COPYRIGHT 1910, BY ARGUTO OILLESS BEARING COMPANY

Final Planer Decision

WHEN it comes right down to the final decision on a planer—a planer for hard, consistent work and for varying, light, high-speed work—in both cases, rapid, accurate reduction, day in and day out, year after year—you don't want to experiment—you haven't the time—your requirements demand that a certain amount of work is turned out each day, and when you want it, not when the machine is ready—you have no time to lose to make adjustments or to wait for repairs—you want something standard—a machine that is right on the job, every minute, from the moment the power is thrown on till the job is completed.

Your work insists on a positive table action, without quake or hesitation—steady, firm and positive cutting action—each table stroke an exact counterpart of the preceding stroke—no hesitation as tool enters work—no excessive vibration along length of table but—instant and positive table reverse—shock and jar reduced to a minimum—table stopped instantly at any point from either side without stopping belts—no noisy gears taking up backlash or shrieking belts reversing table action—ample power and rigid construction to maintain a set cutting speed under varying light and heavy loads.



42-inch Pond Planer, 4-belt Drive.

Pond Planers

The Only Thing Left to Decide is the Size

Write for illustrated circulars.

Niles-Bement-Pond Company

111 Broadway, New York. 23-25 Victoria St., London, S. W.

SALES OFFICES: Boston: Oliver Bldg. Chicago: Commercial National Bank Bldg. Detroit: Majestic Bldg. Pittsburg: Frick Bldg. St. Louis: 516 North 3rd St. Philadelphia: 21st and Callowhill Sts. Birmingham, Ala.: Brown-Marx Bldg. Agents: The Canadian Fairbanks Co., Ltd., Montreal, St. John, Toronto, Winnipeg, Calgary and Vancouver. Agents for California, Nevada and Arizona: Harron, Rickard & McCone, 139 Townsend St., San Francisco, Cal., and 164-8 North Los Angeles St., Los Angeles, Cal. Ing. Ercole Vaghi, Milan, Italy. F. G. Kretschmer & Co., Frankfort a.M., Germany. F. W. Horne, 70 C/- Yokohama, Japan.

(*See pages* 51, 52, 53, 54, 55, 56, 57 *and* 58)

Making Cutters for Gear Teeth

By F. A. Stanley

Laying out tooth curves for special fly tools and formed milling cutters for cutting the teeth of brass and steel wheels and pinions. Applications of a templet with the curve, traced on an enlarged scale, to a special machine where the lap for finishing the fly cutter is accurately ground to the required contour.

The equipment for grinding the cutters to correct form, and the method of mounting work and cutters for convenient operation.

The accompanying halftones and line engravings illustrate a number of special machines and appliances for making fly cutters and formed cutters, used in the cutting of teeth in the wheels and pinions for a certain mechanism operated by clock gearing.

The teeth on these gears and the leaves of the pinions are of a form resembling those commonly used in clock and similar work, and for each size and pitch of wheels and pinions a special cutter with the correct form of tooth is produced; fly cutters being used for the teeth of brass wheels and formed milling cutters for steel gears.

The Starting Point

In this system the starting point of the mechanical work is the production of a templet, having a curve ten times the size of that required on the fly cutter. The curve is traced upon this templet by the apparatus illustrated in Fig. 1.

Assuming for example that a wheel and a pinion are required in the ratio of three to one, say with a center distance of 0.48 inch, this would mean that the distance between centers would be divided into four parts, the radius of the large wheel being three-quarters of the total center distance, the radius of the pinion, one-quarter. These radii work out, then, to 0.36 inch and 0.12 inch, and the respective pitch diameters of wheel and pinion would be 0.72 and 0.24 inch, as indicated in the sketch, Fig. 2. If we select 12 as the number of leaves for the pinion the wheel will have 3×12, or 36 teeth.

Making the Templet

The templet blank is a steel strip about ¾ inch wide, 3 inches long, and 1/16 inch in thickness. Two holes are drilled through it and it fits accurately in the slot shown in the fixture, Fig. 1, the two holes fitting nicely over two dowel pins in the slot, as shown more clearly in Fig. 3, which is a plan view of the device.

Two brass disks are laid out, like *A* and *B*, to ten times the pitch diameters of the gear and pinion required. If the wheel is to be 0.72 inch and the pinion 0.24 inch, then the disks will be 7.2 and 2.4 inches diameter respectively. Center lines are scribed across the brass disks and there is a small steel spindle at the center of each for holding and manipulating it. The two disks are placed upon the plate *C*, Figs. 1 and 3, with their peripheries in contact with each other and coinciding with a line scribed at *D* upon plate *C*. In one of these disks is placed a scribing point *E*, whose keen edge is exactly on a line with the circumference of the disk.

If the templet *F*, underneath the disk, is to be laid out for a cutter for making the teeth in the wheel, the disk for the latter, which is, of course, the larger of the two, is held stationary, while the smaller disk carrying the scribing point is revolved about the edge of the large disk. The scriber then traces a curve upon the templet beneath, as indicated by the points *E*, E^1, E^2, Fig. 3. In case a templet is to be made for the teeth of the pinion, the blank disk, made to ten times the pitch diameter of the pinion, is held upon the plate while the larger or wheel disk to which the scriber point is transferred, is revolved in contact with the edge of the pinion disk. In either case the curve traced upon the templet is a cycloid.

Fig. 1. Bench Plate and Disks for Laying Out Tooth Curve on Templet

The templet *F* upon being removed from the fixture is accurately filed to the curved line traced upon its face, is hardened and lapped.

Form of Tooth Used

It may be well at this point to illustrate the general form of tooth used in these wheels and pinions. As already mentioned, the curve above the pitch circle is epicycloidal; below the pitch line the sides of the teeth are straight, usually radial lines. The top of the tooth runs to a point, as shown in the sketch, Fig. 2, and the dedendum is carried down sufficiently to form a slight clearance for the point of the meshing tooth. The cutter is made a few thousandths wider than the gear tooth figures out, in order to provide sufficient clearance in the space for the corresponding tooth on the other gear, and in making the fly cutter or the rotary form of cutter, the length of the straight sides of the tool must be determined; also the width at the pitch line.

Making an Accurate Lap

The fly cutter is ground to its correct shape by a steel disk of the proper contour, charged with diamond dust. The preparation of this lap, that is, the shaping of the curved corner to produce the proper curve on the fly tool, is accomplished by means of another lap, operated in the machine in Figs. 4 and 5.

The lap for finishing the fly cutter is shown at *G*, Figs. 4 and 5, and several laps will be seen at *H*, Figs. 6 and 7. The lap is a disk approximately 1¼ inches diameter, ¼ inch wide on the face, recessed for the greater part of its diameter, and of the required curvature on the edge. This disk is put in the machine in Figs. 4 and 5, to have its working

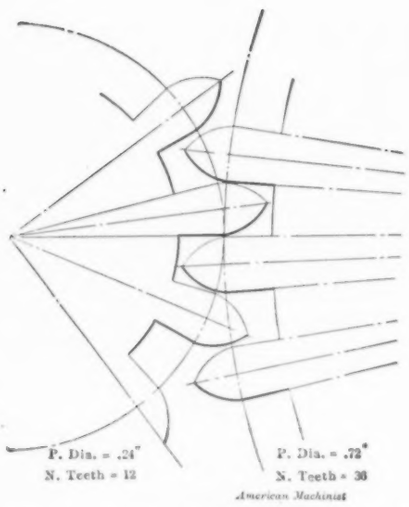


FIG. 2. LAYOUT OF WHEEL AND PINION TEETH 10 TIMES ACTUAL SIZE

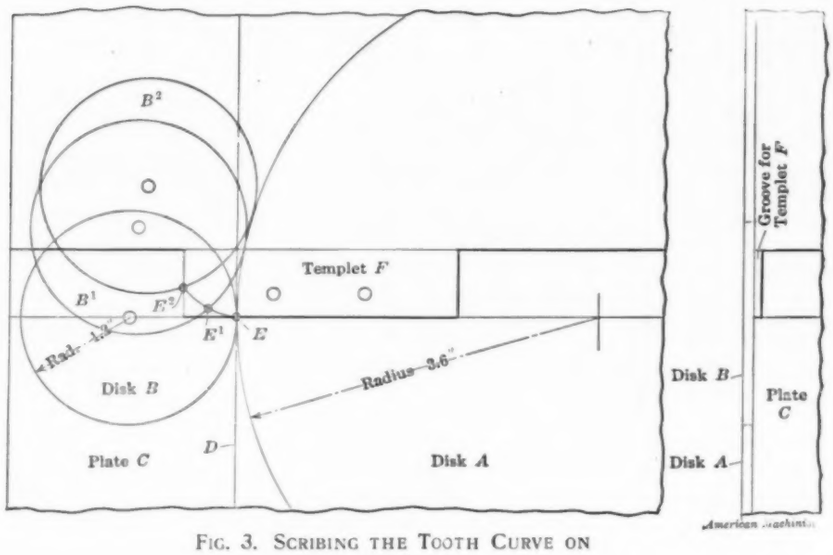


FIG. 3. SCRIBING THE TOOTH CURVE ON THE TEMPLET

face or corner finished correctly prior to charging with diamond dust, and it is here that the templet *F*, laid out in the fixture, Figs. 1 and 3, is brought into use.

The grinding wheel of the machine in Figs. 4 and 5 is also a lap *I* made of a steel disk charged with diamond dust, driven at a high rate of speed by a small spindle passing through a sleeve, which is bored eccentrically and driven at a slower rate of speed by another pulley, pulley *J* driving the lap itself and pulley *K* rotating the eccentric bearing sleeve, through which the lap spindle passes. The lap *I* is recessed similarly to lap blank *G*, which is to be finished to the required form and its rotary motion about its own axis, combined with the revolution of the spindle and its carrying sleeve about the axis of the sleeve itself gives the lap surface a to-and-fro movement in a plane at right angles to its axis, which constantly presents different portions of the cutting face of the lap to the work, this keeping the face true and producing accurate results on the surface of the disk *G*, which is being finished.

THE FUNCTION OF THE TEMPLET

The templet is shown attached at *L*, Figs. 4 and 5, to a rock shaft *M*, at the other end of which is mounted an adjustable head for carrying the spindle for lap blank *G*. When the templet is swung in contact with slide *N*, the lap *G* to be finished is swung up at an angle to the facing lap *I*. At the same time the lever *O* which is so pivoted and connected to the slide for lap *I* as to give a ten-to-one reduction of the movement of the slide, as compared with templet slide *N* is forced by the curved edge of the templet to carry the lap *I* to and from the face of the lap blank *G* as the latter is rocked up and down and fed into contact with the lap *I*. Adjustment of the slides *P* and *Q* brings the work into correct position relative to the tem-

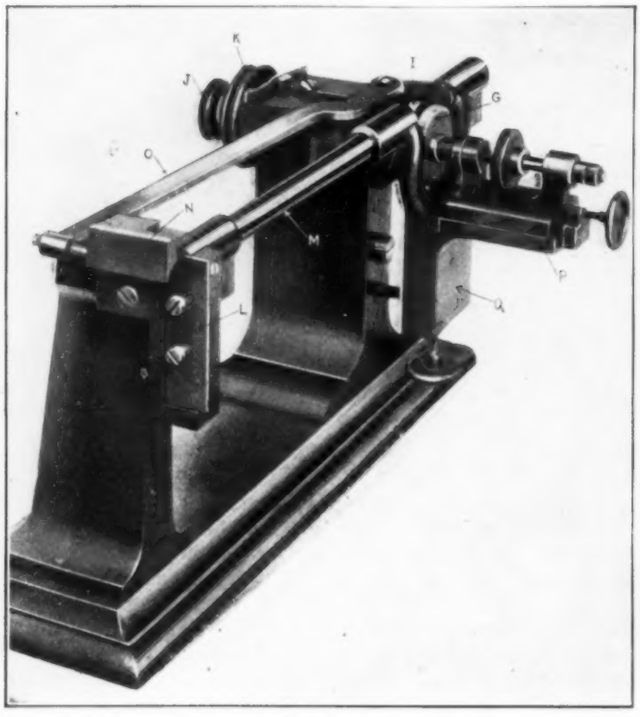


FIG. 4.

FIG. 5.

MACHINE FOR FINISHING LAPS FOR FLY CUTTERS

FIG. 6.

FIG. 7

LAPPING THE FLY CUTTER

plet *L* and the cutting lap *I*, and it will be seen that the curve upon the templet is thus reproduced to one-tenth its size upon the edge of the lap *G*. When the corner of this lap disk has been accurately finished to the curve of the templet, but to one-tenth its size, it is charged with diamond powder and is then ready for use in the machine illustrated in Figs. 6 and 7, where it is shown in operation upon a fly cutter.

LAPPING THE FLY TOOL

In this machine the blank for the fly cutter is held at *R* in a holder which is mounted on an arm that may be swung to and fro to present one side of the cutter to the lap *G* and then swung back to bring the opposite side of the cutter to the other side of the lap. In each case the same edge of the lap is used, hence

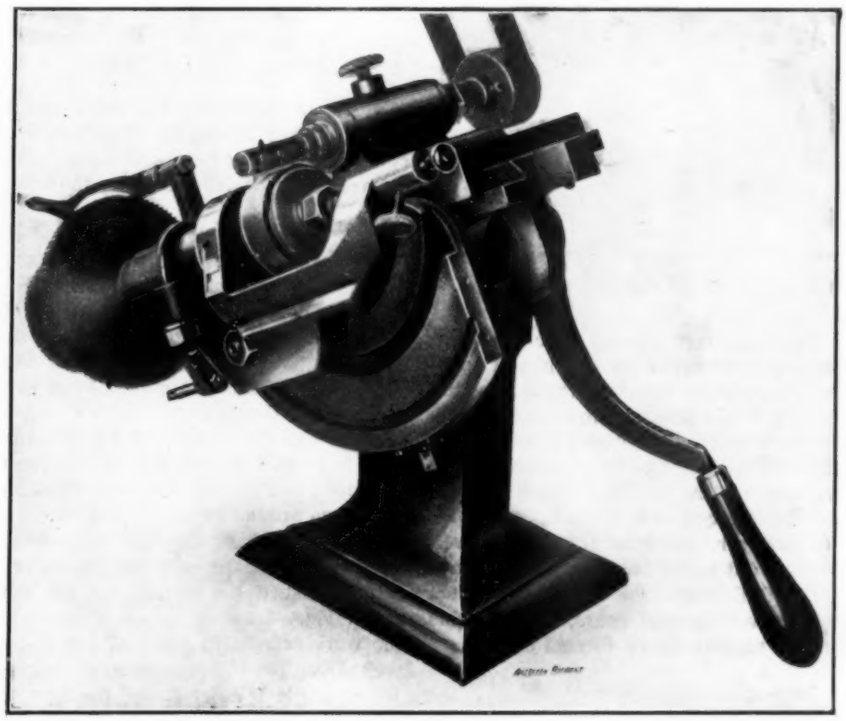


FIG. 8. GEAR CUTTER SET UP FOR CUTTING TEETH WITH FLY CUTTER

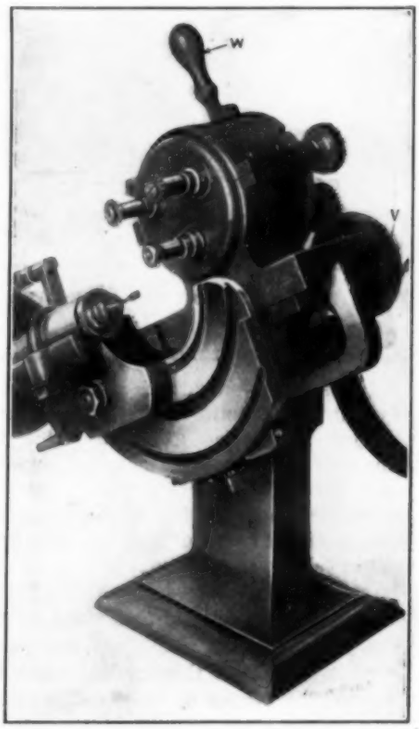


FIG. 9. BENCH MACHINE SET UP FOR MILLING STEEL GEARS WITH FORMED CUTTERS

the curved form is accurately reproduced upon both sides of the fly tool. This lap, it will be understood, having been made from a templet ten times the actual size required, is accurate within all necessery limits; hence the fly tool is bound to be practically correct.

The swinging arm upon which the fly-tool blank is carried has a graduated swivel and adjustable stop screws *S S* are provided, so that the work may be swung to within as many degrees of the center line as is necessary to bring the straight faces into radial paths. The spindle upon which the lap is mounted is arranged to permit of adjustment laterally, and the face of the lap is set directly over the pivotal center of the tool-carrying fixture. The fly cutter is secured in its holder directly on the horizontal center line of the lap.

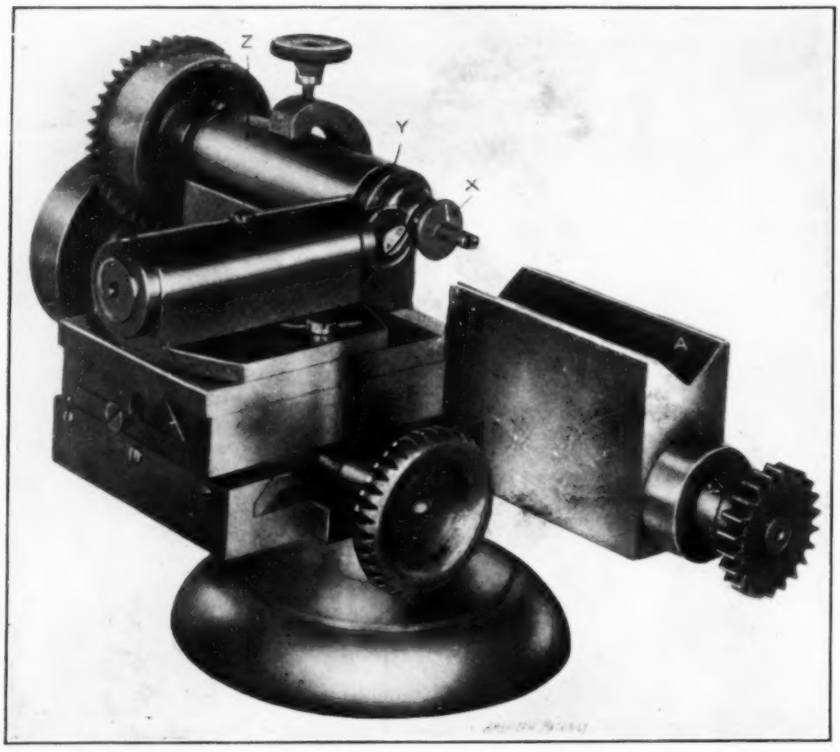


FIG. 10. BENCH LATHE FOR FORMING A GEAR-CUTTER BLANK

CUTTER CLEARANCE AND WIDTH OF POINT

In order to provide clearance to the fly cutter the cutter blank, while being shaped with the lap, is rocked slightly to one side by means of a stop at *T*, Fig. 6, and swung over in the other direction when the opposite side of the cutter is being ground at the back of the lap. When in use, the fly cutter is required to be ground, it is put back in this lapping fixture and the form at both sides of the cutter relapped to shape and the point then lapped off to the required width in the block shown at *U*, Fig. 6. This block is simply a piece of steel with a hole at the correct angle to receive the cutter, a clamping screw to hold it and an adjusting screw at the back to push it forward. The cutter is simply pressed down into contact with a flat lapping plate, while the block is rubbed to and fro over the face of the lapping surface until the point is brought to the required width, as measured by micrometers.

The operation of lapping up the two sides of the fly cutter is completed by using a rotary boxwood lap in place of the steel lap shown in place upon the spindle of the machine in Figs. 6 and 7. The boxwood disk is used merely as a burnishing device and may be covered with Vienna lime for polishing the surface nicely.

HOW THE FLY CUTTER IS USED

Assuming the fly cutter to be ready for use, it is now placed in the machine, Fig. 8, where it is shown operating upon a string of brass wheels. The latter are held upon an arbor, as shown, and while the fly cutter is revolved rapidly by the spindle of the machine, the hand lever is operated to pass the wheel blanks under the cutter. The means of adjusting the work to the cutter, the method of moving the cutter spindle, the indexing device for the work, and other features are well brought out by the halftone engravings.

Fig. 9 illustrates the same machine, set up for milling steel gears, using in this case a regular rotary formed cutter.

MILLING STEEL GEARS

With this arrangement there are three spindles mounted in an indexing head, each driven by gearing from the small pulley *V* at the right-hand side, which is bolted from a countershaft at the back of the wall. Indexing of the spindles is accomplished by moving the handle *W* back and forth, this movement actuating a pawl ball and ratchet device for advancing the turret step by step to bring one spindle after another into position for operating upon the blanks. No work is shown in place, but a work arbor will be seen held in position in the draw-in chuck in the work spindle.

The three cutters used on steel wheels consist of a thin saw, which cuts a narrow slit in the work, a formed cutter, which is used to cut the tooth space to two-thirds of the depth, and the finishing formed cutter, which completes the tooth.

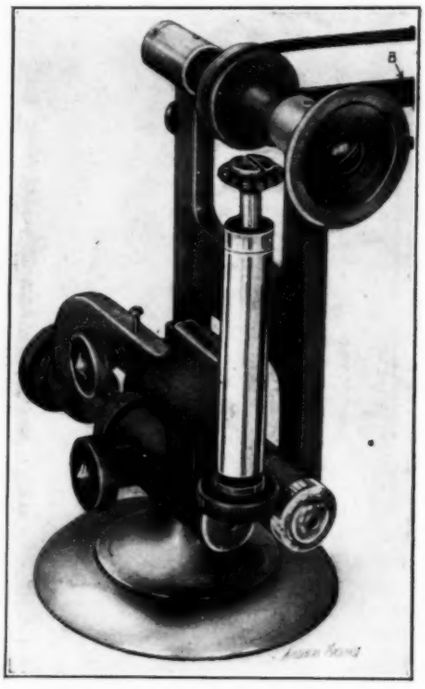


FIG. 11. GRINDER FOR SHARPENING FORMED CUTTER TEETH

MAKING FORMED MILLING CUTTERS

The formed cutters are finished to correct shape in the machine shown in Fig. 10. In this bench machine the work is held in a quill, which is clamped in the V-shaped seat on the bed of the machine. The spindle is driven by a gear operated by the pulley at the left end of the bed and the work held on the arbor at *X* is rotated in contact with the forming tool *Y*. This tool has been accurately formed around its whole periphery and can be ground back from the face without changing its shape. In fact, it is correctly finished by lapping on the machine, Figs. 4 and 5, where it is put on the work spindle in place of lap *G* and rocked up and down against lapping wheel *I*, the templet *L* and the lever *O* controlling the contour of the cutter disk the same as in the case of the lap blank *G*.

After the cutter blank *X*, Fig. 10, has been formed on one side, the quill *Z* is turned end for end and placed in seat *A*, the quill gear then being driven from the right-hand end of the machine and without changing the position of the circular forming tool relative to the center of the lathe, the other side of the cutter blank is formed, so that both sides are uniform. The cutter is then ready to be notched, which is done in the bench miller shown in Fig. 8, several cutters being notched simultaneously if necessary.

Backing Off Cutter Teeth

The special form of bench lathe in Fig. 10, shown for making formed cutters, is also adapted for backing off the teeth. For this purpose a reciprocating attachment is operated from the gearing at the left-hand end of the bed, which gives the necessary lateral movement as the cutter is rotated, causing it to be backed off uniformly tooth by tooth.

Grinding Formed Milling Cutters

In Fig. 11 is illustrated another bench machine, which is used for sharpening formed cutters. The wheel in this case is a bevel-edged steel disk, charged with diamond dust and with one face straight for grinding the radial faces of the cutter teeth. The cutter is placed upon the vertical spindle, and the bracket carrying this spindle is oscillated to pass the straight face of the lap across the face of the tooth. As the lap rotates, the bracket in which its spindle is mounted is given a slight oscillating motion in the plane of the wheel face by means of the connecting rod *B*, which is operated from an eccentric on the countershaft fixture placed on the bench, from which the spindle of the lap is driven. This movement of the lap helps preserve the truth of the lapping face and produces satisfactory results upon the cutter teeth.

When desired a notched wheel is placed at the bottom of the work spindle to facilitate uniform indexing for the sharpening of each tooth face. In the illustration this index disk is not shown in position.

Application to Involute Teeth

The general principles involved in this method of producing special cutters for certain classes of gears have been covered sufficiently in the foregoing description to indicate that similar means may be adopted by designers and toolmakers wishing to form, say, fly cutters for involute teeth commonly used in machine construction. In the case of such teeth the curve upon the templet which forms the starting point in this process could be traced by means of a scriber in a straight-edge swung about the periphery of the brass disk seen in Fig. 1. That is, for the involute curve which it is desired to lay out to ten times the size of the fly-cutter curve, the straight-edge with the scribing point could be used in place of the scribing disk shown in that illustration.

Locating Indicator for the Miller

By George J. Murdock

A device for locating jigs and other tool work on the milling-machine table in correct position for the boring of holes, each hole center being located from a center punch mark in which the point of the indicator is placed.

Details of construction and methods of applying the indicator to various classes of work in the shop and tool room.

There are a number of well known methods of locating jigs and other tools on the work table of the milling machine, to be operated on with the boring bar, two of the best known being the button system, using a micrometer head located on the spindle for correctly spacing the buttons, and the system of spacing by means of the milling-machine micrometers.

In the endeavor to not only effect a saving of time, but to also eliminate chances of error in locating such work the tool illustrated in Figs. 1 and 2 has been designed, and quite an extensive experience with it has proved that for any of this work it is a superior device while it is also capable of uses that it is believed require this particular design to successfully execute.

In boring holes on the milling machine for the bushings of jigs, or for any similar work three movements of the table are necessary, namely vertical, and horizontal, for locating the center, and the cross-feed movement for boring the hole. It is, therefore, only necessary in a tool of this class to so design and construct it that it will show when the center on the work is vertically correct with the spindle of the machine for the first movement, and horizontally correct for the second.

Details of Construction

A faceplate is therefore used as shown at *G*, in Fig. 2. It is screwed into the threaded nose *K* of the arbor *H* which is made to fit the taper of the milling-machine spindle, and may be used alone or with a collet. The annular rim of the faceplate extends backward over the end of the arbor, and is provided with four holes at equal distances from each other. Hardened, ground, and lapped bushings *D* are inserted in these holes to receive the pin *S* which is made a gage fit for the hole in bushing *B* on the outer end of sector *C*.

The sector is rigidly secured to the barrel *P* carrying the 60-degree center spindle *O* that comes into contact with the center-punch mark on the work that is to be bored, and which, of course, is secured to the milling-machine work table.

The spheroidal base of the barrel *P* fits into a corresponding concave seat in the nose *K* of the arbor, and is held in place by the spring *E* which is connected at one end to the cylindrical stud *R* that is capable of rotation in the axial hole in the bottom of the barrel *P*. The other end of the spring is attached to a rod *N* which terminates near the tang end of the arbor *H*. A small hole is provided in the end of this rod to draw it through the arbor, and give sufficient tension to hold the connected parts against the nose *K* of the arbor. When adjustments are properly made the set screw *M* is turned up against the rod, holding it and the parts connected to it in place.

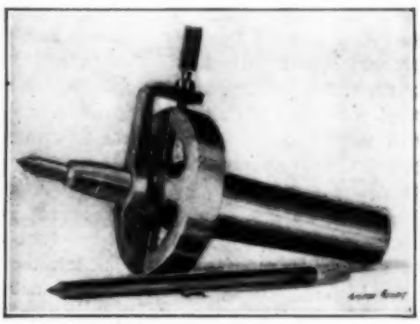


FIG. 1. INDICATOR FOR LOCATING WORK ON THE MILLING MACHINE

Principle of Operation

It will now be seen that if the pin *A* is removed from the bushing *D* the point of the spindle *O* may be made to describe a circle, and somewhere within this circle the center-punch mark is located on the work to be operated on. As the holes *D* on the faceplate *G* are all exactly the same distance from an axial line through both the arbor *H* and the spindle *O*, it follows that the center on the work must be so located by vertical and horizontal

movements of the milling machine table that the pin *A* can be entered freely into all the holes in the rim of the face plate.

When this is done a drill followed by a boring bar will accurately produce a hole at the desired point on the jig or other work as laid out.

Locating the Center Punch Mark

The prick-punch mark should be of slightly greater angle than the point of the spindle *O* as it is not possible to so locate the work that in the preliminary trials the center will be exactly in line, but will invariably be found too high or on one side of the correct location. In bringing the work by means of the cross feed into contact with the center *O* the spring *J* should be only slightly compressed which will hold the point *O* against the center-punch mark in the work while the trials are being made that will finally locate the center and permit the pin *A* to enter all four holes in the faceplate.

As the work comes nearer the center the spring *J* will continue to be compressed as the spindle slides back into the barrel. This spring should not be made so stiff as to interfere with the free rotation of the sector *C* bearing the pin *A* around the rim of the faceplate *G*. When the work is finally located, and is ready to bore the cross-feed screw draws the work away from the indicator, and the center spindle *O* is prevented from being thrown from the barrel by the set screw *L* with point located in the flattened recess on the side of the spindle.

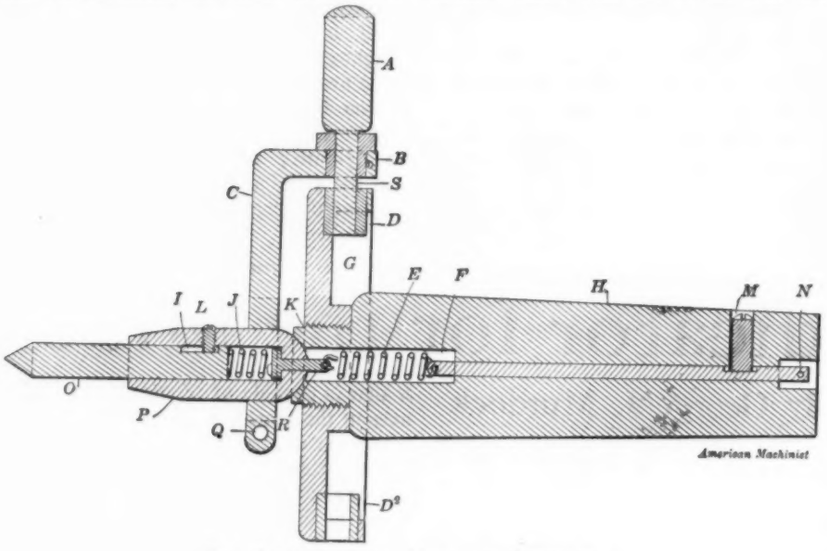


Fig. 2. Sectional View of Indicator

Setting the Indicator

In using this tool the milling-machine spindle is not rotated, only the barrel *P* being turned on the nose *K* of the arbor. The spindle of the milling machine is so set, however, in the beginning that a line drawn vertically through bushings *D D* would be at right angles to the work table, while a line drawn axially through the other two holes in the faceplate will, of course, be parallel with the top of the work table.

As the pin *A* projects outwardly and at right angles to the spindle of the machine it is not in the way in locating the work. The center spindles *O* are made of various lengths to suit the varying conditions under which work must be done. All are interchangeable with the barrel *P*, and it will be seen that the longer the spindle is the greater the degree of accuracy attainable. Fig. 1 shows the tool as actually made with one of the long center spindles in the foreground. The pin *A* of the sector is nurled so as to be easily turned with a light wringing motion into the holes in the faceplate rim when the work has been centralized so that it will enter. As one essential of a tool of this character is compactness it will be noted that the faceplate unscrews from the spindle in such a way as to leave the calibration correct when again assembled, at the same time allowing the parts to be made in such a form as to lie flat in a drawer of the toolbox.

Other Uses of the Tool

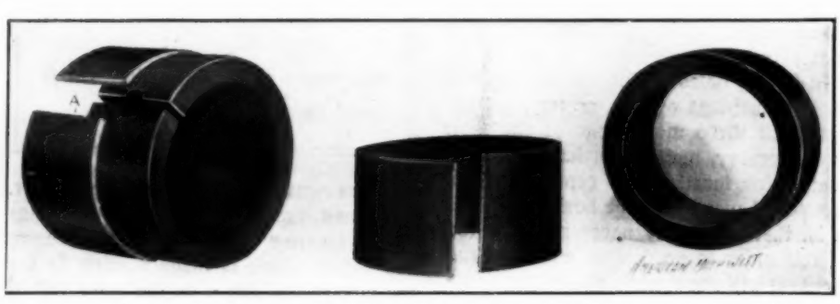
Other applications may be considered besides the one herein specifically described, such as setting an engine lathe tailstock center in line with the headstock spindle so the lathe will turn parallel. This is commonly effected by turning an arbor between the centers until the micrometer shows it to be of the same diameter at each end, and is quite a tedious proceeding. Equally good results may be attained by using an indicator as described fitted to the tailstock spindle taper. In such cases the center spindle *O* is made female to bear against the center of the headstock spindle of the lathe. In adjusting, the tailstock is set over until the pin will enter the two holes that are in the same plane as the top of the lathe shears. As the tailstock spindle is nearly always higher, especially in new lathes, the vertical members of the quadrant of the faceplate are not used, the lathe, however, turning parallel.

When this instrument is thus fitted to a lathe it may (after the lathe is set to turn parallel) be used to locate work on the faceplate, and a saving of time over the button method as heretofore practised result, while if the indicator is accurately made equally satisfactory work may be done if uptodate methods are followed in laying out the exact locations for the holes to be bored.

The boring mill is of substantially the same character as the engine lathe so far as its relation to this tool is concerned, and many classes of work may be done by the use of this tool quicker, with less liability of mistakes, and with greater accuracy than by the methods commonly followed.

Repairing Rod Bushings

They have a very simple way of giving solid-end rod bushing a new lease of life at the New York Central shops at Depew, N. Y. When a rod bushing has become worn beyond the running limit, it is simply forced out of the rod end and a slot milled through the oil hole at the top, as shown at *A*. Then a liner of sheet metal is cut just long enough to wrap around the box and not cover this hole. The liner and box together are then forced back into the rod and the bushing is ready to be bored and go back into service with the probability of securing as much mileage as when new.



Repairing Solid-end Rod Bushing

Use of Pressed Steel in Motor Cars

By John Coapman *

As the automobile becomes more and more widely used, the quality of the cars offered for a given price continues to improve and cheaper and better cars are constantly being put upon the market.

To make this possible many changes are being made in design, material and method of manufacture, one of the most important being the use of forgings and sheet-steel stampings in place of castings.

Two or three years ago, before the use of the automobile became so prevalent as it is today, manufacturers had not looked into the possibilities of pressed-steel construction. However, as soon as it became evident that their greatest trouble would not be in the disposal of their product, but in the production, cheaper and quicker methods were looked for. Especially was this true with those manufacturing a medium, or a low-priced car. Today it is possible to purchase a better car for about one-half of the cost two years ago.

It is plainly evident to all that something has been adopted to replace the construction of a short while ago, to enable the manufacturers to make their product for the price asked. We often hear that increased production has brought greater skill to the mechanics, but to those who care to go through any of the large automobile plants, where they turn out from 50 to 100 cars each working day, it is evident that the mechanic of old is not in very much evidence; if he exists at all he is probably a toolmaker or else a factory executive.

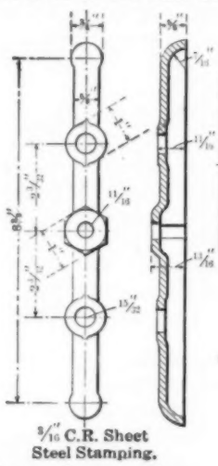


FIG. 1. INTAKE MANIFOLD CLAMP

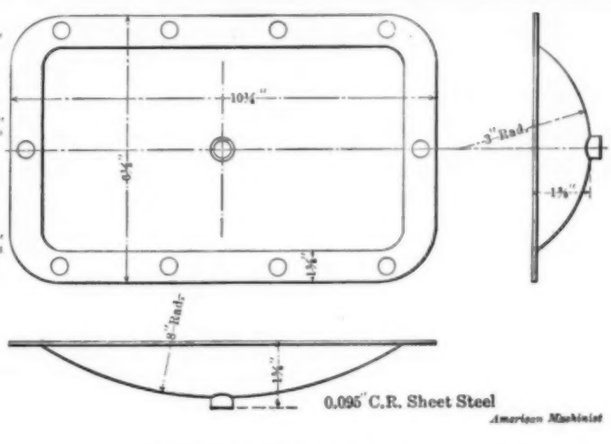


FIG. 2. HAND-HOLE COVER

Aside from the introduction of gages, jigs and fixtures for practically every operation, one of the most important modern changes is in the substitution of forgings and stampings for castings. It requires a considerable outlay of time and money to make the dies for forgings and stampings, but the decreased labor cost upon the finished product is much more important than the tool cost. A few examples of stampings as used by some manufacturers may be of interest to many.

Fig. 1 shows an intake manifold clamp, made from 3/16-inch cold-rolled sheet steel. Formerly this was made from a casting, but since the change the saving has been considerable. To those who are in a position to know, this stamping has been acknowledged to be one of the most difficult. It comes from the press all ready to be assembled upon the motor. When it is considered that the material in the sheet can be purchased at a fraction of the cost of the casting, and that a press can make about two thousand, or more of these per day, it is readily seen that the saving is enormous.

Fig. 2 is a hand-hole cover used on the lower portion of the motor crankcase, the removal of which enables one to make examination or adjustment of the working parts. Very few manufacturers today are using castings for this purpose, as they have found that castings cost considerably more and are not as good as the stampings.

The majority of cars have their motors supported either on a sub-frame or on the main frame. One thing is evident, though, and that is; with but one or two exceptions, the supporting arms are cast integral with the crankcase. These arms require some machining and this operation is one of the meanest of jobs. Also the casting is necessarily clumsy because of these arms. Fig. 3 shows a supporting arm made of ⅛-inch cold-rolled sheet steel which is attached to the crankcase by the same bolts that hold the main end bearings of the crankshaft.

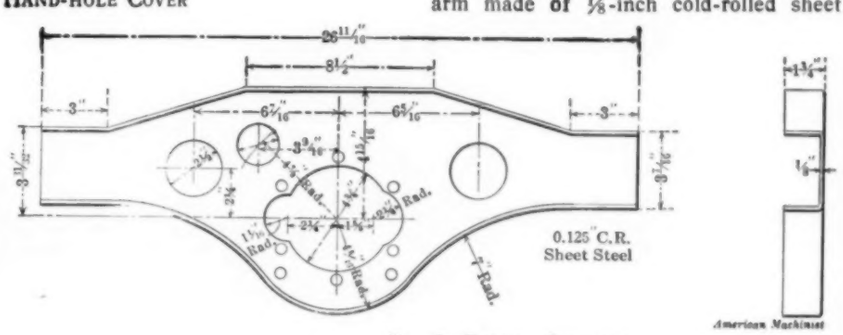


FIG. 3. ENGINE SUPPORT

Where the inverted type of cone clutch is used, it is necessary to provide a housing for the cone, and this has to be bolted to the flywheel. Some manufacturers use a casting for this purpose, but Fig. 4 shows how one maker utilized pressed steel at a considerable saving. For his clutch, he used a forging for the hub, and a pressed-steel cone. He saved here on

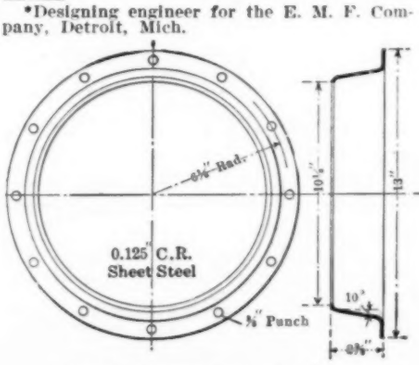


FIG. 4. OUTER CLUTCH CONE

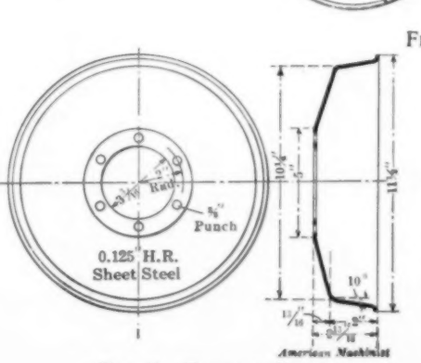


FIG. 5. CLUTCH CONE

*Designing engineer for the E. M. F. Company, Detroit, Mich.

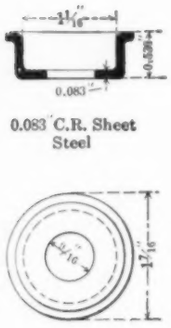


FIG. 6. FAN BALL CUP

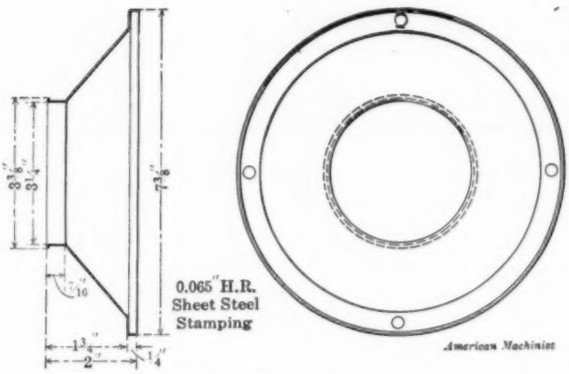


FIG. 7. SERVICE-BRAKE DRUM COVER

the first cost of the material but his main saving was on the labor cost. This cone is shown in Fig. 5.

In one case it was necessary to use ball bearings in the fan and yet the price of the car would not admit using imported bearings. An adaptation of the bicycle type was used, and Fig. 6 shows the pressed-steel cup.

One car had the foot, or service brake mounted upon the transmission, instead of on the rear axle. The universal was inside of the brake drum and it was necessary to keep the dirt out. This end was attained by using a pressed-steel cover which is shown in Fig. 7.

tubing. Fig. 9 shows a very interesting example of the use of pressed steel for the manufacture of a rear-axle housing. The dies for this part cost in the neighborhood of $9000, but as over 15,000 cars have been made, each using two of these, the dies have more than paid for themselves.

When the above construction is used, it is necessary to add a reinforcing flange, and this is shown in Fig. 10. It is possible to write volumes upon this subject, as its uses are constantly increasing.

The carbureter may be supported by a

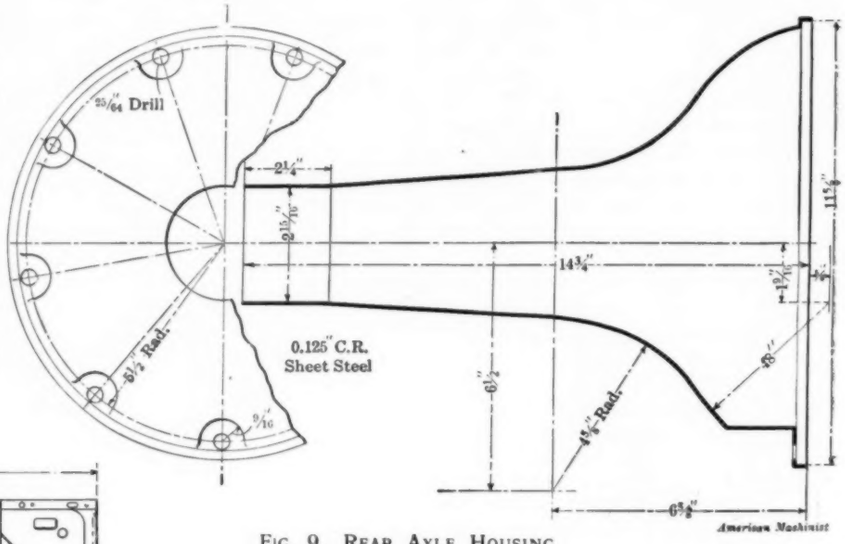


FIG. 9. REAR AXLE HOUSING

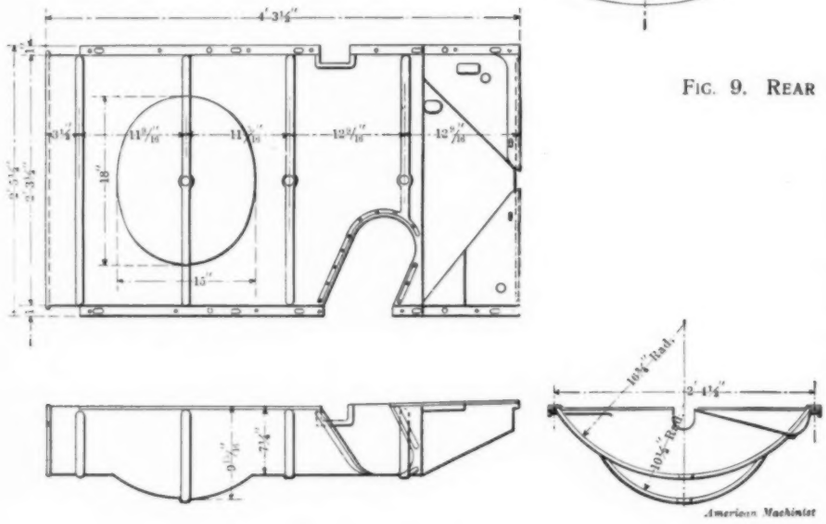


FIG. 8. ENGINE-PAN STEEL STAMPING

stamping, as shown in Fig. 11. Some builders support the carbureter by the inlet manifold, but this imposes too much upon it and results in leaky joints.

Fig. 8 shows what is probably the most interesting example of all, interesting because of its size. This is the mud. or dust pan which protects the motor from the road. It is usual to make this pan in two or three pieces, and it is only lately that the one-piece pan has become at all common.

Another two or three years will undoubtedly show a great many more improvements in motor-car construction,

The use of pressed-steel frames is familiar to all, and while most cars use a cold-rolled carbon steel for their cross members as well as the side bars, one large manufacturer uses hot-rolled steel for his product. Its strength is sufficient for the purpose intended. Fig. 12 shows an example of a cross member. Many examples might be shown but one is sufficient.

As commonly made, the rear axle housing is composed of castings and steel

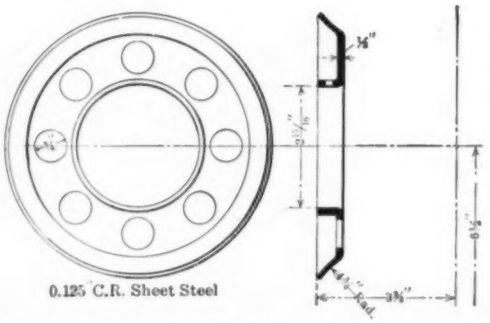


FIG. 10. REAR-AXLE REINFORCING FLANGE

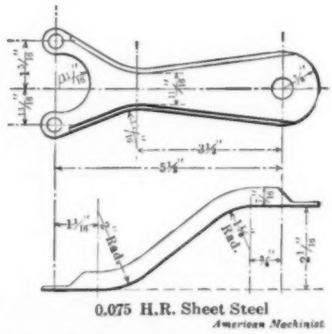


FIG. 11. CARBURETER SUPPORT

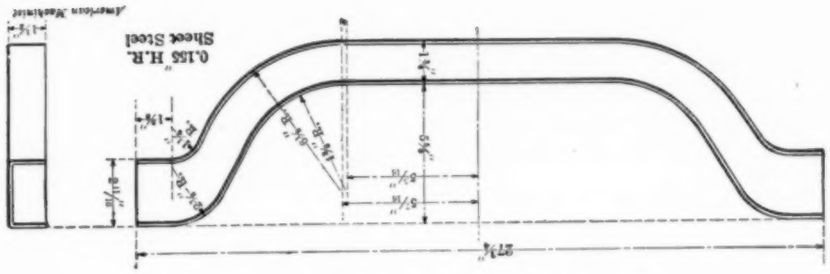


FIG. 12. FRAME CROSS MEMBER

and it is safe to say that the use of forgings and stampings to replace castings will continue to increase.

When we consider that toothed or geared wheels have been in use since about 300 B. C., it seems as though we might be getting to know a little about them. And yet the question of pressure angles, length of teeth and methods of making are far from settled, because the conditions under which they are used have been constantly changing.

Cork Inserts as Applied to Machinery*

By Lawrence Whitcomb†

The nature of cork and reasons for its use. The different ways in which it is inserted into pulleys, clutches, etc., to prevent slippage. Why it increases the efficiency of pulleys run with belts and thus increases the output of machines. Tables showing the gain in efficiency on dynamometer load per horsepower and under actual working conditions.

*Condensed report of paper read at convention of the Society of Automobile Engineers, at Detroit, Mich., July, 1910.

†Treasurer and manager of National Brake and Clutch Company, Boston, Mass.

Every element of cost entering into the production of a motor car is an important factor. I, therefore, offer the following in regard to the use of cork inserts. It will be of interest to such engineers, mechanical superintendents and others as are directly connected with the daily output and economical operation of a factory, for an economical, efficient and almost indestructible means of eliminating losses in power transmission is a matter of interest to everyone so employed.

Leading engineers have repeatedly made the statement in engineering publications that the amount of power lost in mills and factories, between its source and the point of delivery, through the slipping of belts and other friction devices, is far greater than is usually supposed, in some cases running as high as 30 per cent.

WHAT ARE CORK INSERTS?

Cork is the bark of a tree, known as the cork oak, and is the lightest known solid. It has a very high coefficient of friction, and alters its volume to a marked degree under pressure, being compressible and elastic. It is made up, principally, of an aggregation of minute air cells, having thin, air-tight, water-tight and very strong walls, and the resistance to compression continually grows stronger. The elasticity is not only great, but is very persistent. The better grades show an increase in volume of about 75 per cent., even after having been confined under compression for many years, in bottle necks, etc.

It is the elasticity of cork, coupled with its high coefficient of friction and its remarkable ability to withstand heat and wear, that makes it a valuable material for frictional purposes when used under compression as an insert. But while having much elasticity and strength when confined under pressure, it is brittle when not so compressed; and the very grade of cork that proves to be most indestructible when used under compression as inserts, wholly fails, owing to its brittleness and other peculiarities, if used for frictional purposes in its normally expanded and thus weakened condition. It is this fact that has made its successful use for frictional purposes impracticable until the present method of using it under compression was devised.

To obtain this desired compression, sockets are drilled or cast in the face of a pulley, clutch or brake to be thus equipped, and into these sockets are forced corks of a certain grade and of much larger diameter than the sockets themselves. The corks are allowed to dry and are then trimmed and finished so as to have the right amount of projection above the surface of the material surrounding them.

The amount of this projection depends on the nature of the work required of the friction surface. There are, however, two distinct methods of construction, which I particularly desire to call to your attention, because the greatest success in the application of cork inserts to any device is obtained by using them under right conditions and according to approved methods.

ALL-CORK CONTACT

Let us consider first the so called all-cork contact. In this method of construction the sockets are so spaced that the corks occupy a relatively large area and the corks are allowed to protrude above the surrounding surface one-sixteenth of an inch or more, so that they alone come in contact with the opposing surface and transmit all the power.

This drive is most efficient and satisfactory where power is transmitted by means of a large area of cork used at light pressure, as is customary on the frictions of looms and similar machinery and in certain types of plate and multiple-disk automobile clutches.

In this service the pressure and the power transmitted per square inch of cork are so small that there is practically no wear upon the corks, and thousands of automobile and loom clutches thus fitted have been in constant operation for years without requiring repairs.

COMPOSITE CONSTRUCTION

Second, the so called composite construction. In this method of construction the corks are allowed to protrude above the surface of the material, in which they are embedded, but one-thirty-second of an inch, as in the case of pulleys, automobile clutches, street-railway brake-shoes, etc. This method gives an almost indestructible combination surface, of high frictional efficiency and great wearing qualities. At low and medium pressures the corks, with a coefficient of friction of say 0.35, work alone, while at high pressures the inserts are compressed into their sockets, and the surrounding metal, wood or fiber also comes into engagement to supplement and protect the corks.

Under these conditions the tendency of the cork to yield to compression is greater than its tendency to wear. When the pressure applied overcomes the rigidity of the cork, the inserts are pressed into their sockets, practically, flush with the

face of the pulley or other friction surface in which they are set. They do not lose any of their efficiency, up to their full frictional limit, since they remain in contact with the opposing surface and present the same face area as before they were compressed. This tendency of cork to submit to compression and thus protect itself from wear is undoubtedly the reason for the excellent wearing qualities of combination surfaces.

Two important facts to be remembered are that it is the compression of the cork in the sockets which causes it to protrude again above the metal, wood or fiber surface, in which it is embedded, whenever the opposing surface is released; and that the natural physical properties of this material are such that rapid wear is almost impossible.

That cork inserts used under the so called all-cork contact construction have these remarkable wearing qualities, if properly proportioned in area to the load to be carried, can be readily demonstrated.

That cork inserts used under the so called composite construction will withstand heaviest loads, constant abuse and excessive heat is shown by their present use in more than 40,000 motor-car clutches and by the adoption of this construction by more than sixty automobile manufacturers.

Use in Pulleys

In power transmitted by means of pulleys driven by belts, it is generally acknowledged that the capacity of a belt of given dimensions is greater than the capacity of the pulleys over which it runs; therefore, pulleys having high frictional efficiency are most desirable.

The loss that occurs from the slipping of belts reduces product, reaches back to the coal pile and means waste, while on the other hand the failure of certain machines to operate at the desired speed means loss, and in some cases a defective product.

To eliminate these difficulties, pulleys are lagged and relagged, belts are run under excessive tension, to the injury of the belt, and with an increase in journal friction far beyond economical operating conditions. Belt dressing is purchased—sometimes in large quantities and to an extent that means an appreciable yearly charge to expense account.

If cork inserts are used in pulleys such lagging, excessive belt tension and belt dressing are unnecessary.

Pulleys and friction clutches, from the smallest size to the largest, thus equipped, have a friction surface with a high coefficient of friction, long life and uniformity of action under all conditions of temperature, oil, moisture, etc., features in which they excel all others as may be ascertained by the reports of engineers and from technical data available.

Tests

That the cork-insert pulley exceeds all others in efficiency is shown by tests made by Prof. C. M. Allen, at the Worcester Polytechnic Institute, a full report of which is too voluminous for this paper, but from which report we copy the following:

"The objects of these tests is to compare the relative power-transmitting properties of the various standard pulleys with those of iron and wood pulleys fitted with cork inserts. The standard pulleys used were the smooth iron-face pulley and the ordinary wood pulley.

"All of the pulleys were new to start with, but were in prime running condition when the principal tests were made.

"The belt used was leather and was kept in good running condition during the test.

"The belt speed was about one thousand feet per minute; the revolutions per minute of tested pulley were about two hundred.

"The conditions of atmosphere were such as to give a good variety of tests, being made during the months of July and August.

Load on Dynamometer.	Per Cent. Slip. Iron with Cork Inserts.	Iron.
105.0	0.00	1.30
115.0	0.10	1.37
125.0	0.18	1.44
135.0	0.28	1.51
145.5	0.38	1.58
155.0	0.47	1.65
165.0	0.56	1.72
175.0	0.65	1.79
185.0	0.74	1.86
195.0	0.83	1.93
205.0	0.92	2.00
215.0	1.01	2.06
225.0	1.12	2.13
235.0	1.19	2.20
245.0	1.28	2.26
255.0	1.37	2.33
265.0	1.46	2.40
275.0	1.55	2.50
285.0	1.64	2.60
295.0	1.75	2.73
305.0	1.86	2.88
315.0	2.00	3.03
325.0	2.18	3.18

TABLE 1. SLIP ON DYNAMOMETER LOAD.

"From the average results of over one hundred tests, the iron pulley with cork inserts at a point of 2 per cent. slip (which is considered allowable in commercial practice) shows an increase in its power-transmitting capacity of 51 per cent. over the plain iron pulley."

Subsequently to the test in Table 1, it was deemed advisable to make a test of the relative efficiency of several types of small high-speed motor pulleys; and again tests were made by Professor Allen. The pulleys were all five inches in diameter with three-inch face, and were: 1, cast iron; 2, cast iron with cork inserts; 3, fiber faced with cork inserts.

In Table 2 are given results showing the relation between slip in per cent. and horsepower transmitted by the various pulleys tested. This table was made up from curves.

Horsepower.	Per Cent. Slip. Cast Iron.	Cast Iron and Cork.	Fiber and Cork.
1	0.23	0.217	0.155
2	0.46	0.43	0.310
3	0.70	0.65	0.465
4	0.95	0.86	0.620
5	1.20	1.085	0.775
6	1.50	1.30	0.930
7	1.85	1.55	1.085
8	2.35	1.80	1.240
9	3.35	2.10	1.395
10		2.43	1.55
11		2.85	1.72
12		3.40	1.90
13			2.12
14			2.35
15			2.70
16			3.18
17			3.95

TABLE 2. SLIP PER HORSEPOWER.

A series of tests were made at the Lowell Textile School to determine the relative efficiency of various types of commercial pulleys, both with and without cork inserts.

The conditions were as nearly as possible those of actual practice and the greatest care was observed in maintaining them throughout all tests.

The pulleys and belts were new and clean, but were run for a few weeks in preliminary trials before beginning the final tests. No dressing or preparation of any kind was applied to the surface of either pulleys or belt.

The pulleys tested were all eighteen inches in diameter, six inches face, and were of the following types: 1, wood-rim pulley; 2, wood-rim pulley, with cork inserts; 3, wood-rim pulley, lagged with leather; 4, steel pulley.

The initial belt speed in all tests was about 1560 feet per minute, and the initial belt tension was approximately 50 pounds per inch of width of belt.

The comparison of power transmitted at 2 per cent. slip, which is considered a commercial allowance, is given in the first column of the following table:

Type of Pulley.	H.P. at 2 per Cent. Slip.	Maximum H.P. Transmitted.	Slip in per Cent. at Maximum H.P.	Relative Value, 2 per Cent. Slip.
Wood-rim pulley with cork inserts	11.8	13.2	4.6	100 per cent.
Wood-rim pulley, leather lagged	8.7	12.4	4.7	73 " "
Steel pulley	8.3	12.7	6.0	70 " "
Wood-rim pulley	7.8	9.6	4.3	65 " "
Percentage of gain of wood-rim pulley with cork inserts over same without inserts				51 " "
Percentage of gain of wood-rim pulley with cork inserts over plain steel pulley without inserts				42 " "
Percentage of gain of wood-rim pulley with cork inserts over leather-lagged pulley without inserts				35 " "

TABLE 3. ACTUAL PRACTICE TESTS.

Other tests were made, which would indicate that the percentage of gain for

the cork-insert pulleys under conditions of less belt tension than that maintained throughout these tests would be even greater than shown above.

Conclusion

The several reports from which the above tables were taken show that main driving pulleys, receiving pulleys and motor pulleys, and, in fact, all pulleys which may be overloaded or on which slipping may occur, will yield better service if equipped with cork inserts than otherwise.

Both wood pulleys and wood-rim iron-arm and hub pulleys now in use may be equipped with cork inserts in the machine shop of your factory at small expense by obtaining the necessary directions and authority.

Cork-insert pulleys have been put in by a comparatively few factories, but more than 20,000 cork-insert pulleys and frictions are in use in textile mills.

Constructive Industrial Education

By P. Kreuzpointner*

Some comments on the fundamentals of industrial education.

A plea for specific trade schools interchanging time between the shop and the school.

A system advocated that must train the unskilled as well as the skilled.

A two years' industrial course, following the grammar grade, favored.

*Chairman, Industrial Education Committee, American Foundrymen's Association.

The agitation for industrial and trade schools has resulted in preparing the public mind to look more favorably upon the expenditure of public money for the establishment of manual-training schools, domestic science schools, and here and there an attempt for a public trade school.

What has been done thus far is inadequate because of its purely experimental character, or because of the circumscribed private or local condition, or yet because of the narrow scope the originators confined themselves to. But for all that has been done, the conviction is growing that the coming industrial education must not only train the highly skilled mechanics, but its scope must be wide and broad enough to include the semi-skilled and wholly unskilled industrial workers as well.

Moreover, while the character and processes of the industries of our country vary in different localities and sections of the country, their larger interests are national and even world wide, and therefore the scope of the coming industrial education should be national first and local afterward. This being so, it is conceivable that the interests of all concerned, of the industries as well as of all industrial workers, would be served best if the foundation upon which the superstructure of specific trade training and higher industrial education is to be reared, be general in its character and be in close relation with our educational system.

Manual training, if broadened and deepened in the manner indicated below could be made to serve as a foundation. With an increasing severity of economic conditions, the absolute necessity of a thorough industrial and trade education of all industrial workers will force itself to the front, and a differentiation of courses in our public and high schools will be the first step taken by our schools to meet the economic requirements. This differentiation should be such that, wherever the course terminates it should include a first-class education in the subjects of that course. For instance, the course differentiating from the seventh grade and having industrial education for its final object, should, at 14 years of age, be complete for those who do not expect to go to school any longer.

At the same time this course would be preparatory for those who expect to enter the industrial high-school course. Here again the industrial course should be so arranged that those who expect to become mechanics at 16 have received all they could reasonably expect to receive as a preparation. Upon the other hand those who intend to enter an engineering college would have still two years in which to round out their preparation with the help of the first two years. Of course, such a proposition will at once run counter to the sacred tradition of the American school that there should be no stopping place in the American educational system, but an uninterrupted advance from the primary grade to the university.

What Differentiation Would Mean

It is in this traditional fetich ruling our educational system, that the high schools must be feeders of the colleges and the grammar grade must necessarily be the feeder of the high school, that we encounter the greatest obstacle to differentiation in favor of industrial education. All subjects in all the grades are dovetailed into each other so as to finally meet the entrance requirements prescribed by the college to the high school. It is this tradition, and in addition the lack of sympathy of the teachers with the industrial subjects, which would emasculate specific trade education in the public schools as it has emasculated manual training. No other alternative is left but to realize that the courses for industrial education must branch off from the common-school system at some stage of its progress.

It means the establishment of a system of separate schools for industrial education to do justice to our industries and our industrial workers. These schools to be part of the public school system but branching off at the seventh grade and be so organized as to meet the needs of those who go to work at 14 years of age without, however, hindering the progress of those who wish to go higher. Educators begin to see that one serious defect in the present school method is that too much is taught having no application after leaving school unless the pupil receives more schooling afterward. Differentiation of courses will relieve the school from some of the subjects which could be taught more thoroughly in the industrial school.

Nature of Instruction

Having made up our minds as to the necessity of a system of industrial schools, distinct within themselves, the question will be asked what is to be taught in these schools. Since these schools must serve all classes of industrial workers, the instruction must be general and preparatory rather than specific and specialized.

They must try to lay a solid foundation of sound primary principles and reasoning powers to serve as an efficient preparation for whatever industrial occupation is to be followed. The training must be such as not only to develop the mechanical abilities and earning power, but also awaken a sense of responsibility and be disciplinary in character. The fact that in the modern industrial world nearly all business transactions are carried on on a large scale requiring a highly specialized organization for proper execution demands the subordination of the individual will to the details of the organization. This has become essential to the success of any industrial undertaking and therefore a comprehension of

this fact should appeal to the selfish instincts of the pupils of industrial schools. All the more so since this principle applies with equal emphasis to the social-economic welfare of the community.

Constructive industrial education must also recognize the economic value of training the unskilled as well as the skilled. All our efforts thus far have been directed toward the top. We have been training foremen and specialists and guided the young men toward college rather than toward the shop. This seems to be a reversal of the principle of natural selection. The application of this principle would suggest a system of industrial education open for the mass of industrial workers and so arranged that the talented ones can escape upward where they ought to find schools to guide their talents in the direction of greatest usefulness to themselves and to the community.

The aggregate economic loss by leakage in our modern industrial plants, due to careless or misunderstood manipulations during the daily operations by unskilled labor, is enormous and has to be included in the cost of production. Considering the great proportion of semi-skilled and unskilled industrial workers to highly skilled workers, with no provision whatever for the systematic education of the former, any system of industrial schools which ignores the aggregate economic importance of the unskilled workers is deficient and inadequate.

Subjects to Be Taught

In all successful schemes of education the acquisition of knowledge of general principles precedes the application of these principles for specific purposes. The better able the specialist is to roam over a large field of knowledge the more successful he will be.

Some form of manual work should be taught in all grades, from the kindergarten up. Supposing at the seventh grade the desired division of courses takes place, then the manual training in the industrial course should assume a more distinct industrial aspect by closely relating the language and arithmetic taught to the manual work. Arithmetic should be applied in terms of accurate measurements and calculations. But it should be so applied sparingly in conformity with the immature minds of the pupils.

Language should be similarly taught in relation to the work on hand, to gradually acquaint the pupils to the use of technical terms. Correct language should receive a maximum of attention. In teaching history and geography, instead of memorizing the names of countries, mountains, rivers, battles and events which are mostly without meaning and interest to the pupils, a history of our industries would be more proper. While we do not have anything like the history of the guilds of European countries, yet the history of the industrial development of the United States is rich enough in such historical events as would serve to arouse the patriotic interest of the pupils.

At the same time this part of our history could be easily correlated with the geography of the country. Take, for instance, the letter of Governor Winthrop, of Massachusetts, wherein, in 1648, he tells his son that "their blast furnace is doing exceedingly well, having been able to produce eight tons of pig iron the past week." Think of the stretch of imagination which is covered by the 260 years of our industrial history, from the time when the production of 8 tons of pig iron per week was considered a record-breaking performance, to the present time, when we have blast furnaces producing 800 tons of pig iron in 24 hours.

Subjects Should Be Made Interesting

What boy would not be fascinated by following the New England farmer to his humble home and see him making nails on the sly, for his own use, in the middle of the night, so as not to be discovered by the British and be fined for making his own nails instead of buying the imported ones? How amused the boys would be if they would learn that the War Department, during the Revolutionary war, sold some of the Hessian prisoners of war who were with the English army, to the ironmasters in Pennsylvania for £30 sterling each. And thus these Hessians subsequently helped to make shot and shell for the United States army to be used against the British.

While seventh- and eighth-grade pupils are too young to understand anything about the economic principles entering into industrial life, yet they are not too young to grasp the idea that with ninety millions of people to be fed, housed and clothed, we cannot be as lavish and wasteful with the use of our resources as our grandfathers could afford to be, when to their eyes every resource seemed to be inexhaustible.

A good teacher could weave this material into a sense of understanding for civic responsibility, to be developed more fully later on. That kind of teaching presupposes, of course, competent teachers. In the eighth grade, allusions to business methods and the rules of hygiene, as well as to physical laws, could be gradually introduced. What the teaching in these two grades should aim at is good language, familiarizing the pupils with industrial terms, acquaint them with the names and use of tools without insisting upon too great accuracy which their minds is not yet ready to grasp to develop their intelligence and to guide the boys toward a comprehension of the requirements of the actual life.

Continuation Schools

Those employers who engage boys and girls at 14 years of age should see their way clear to send them to a continuation school on the Cincinnati plan. As a mere business proposition, if for nothing else, they would find it would pay to do so. Besides the resulting benefit to the community would be very great. This idea of continuation schools for employees is beginning to find favor quite rapidly.

The Idea Is Spreading

Thus, several large commercial houses in Boston have made arrangements with the school authorities for the establishment of continuation schools for their employees. The success attained in the first ten weeks' course exceeded the expectations of the most hopeful. The employees of the shoe and leather industry attended and were paid their wages while attending school. Among the subjects studied were production and distribution of leather, location of hemlock and oak forests, hides, vegetable tanning, commercial geography of the leather industry, mineral geography of the leather industry, mineral tanning materials, commercial arithmetic, commercial correspondence, leather problems, manufacturing, various kinds of leather, shoe manufacturing and office method.

Needless to say that the same kind of teaching is to be applied to evening classes. But it is the day continuation school, outlined above, which gives most satisfaction notwithstanding the loss of time and pay of wages while they are at school.

Industrial High School

The classical high school of the old traditional organization, with its manual-training annex, is entirely inadequate to meet the requirements. Nor has the manual-training high school proved satisfactory in that respect. They have trained away from the shop rather than for it. A four years' industrial high-school course, running parallel with the classical high-school course, is liable to meet the fate of the present manual-training high school.

Strong social and economic forces unite to bring this about and this tendency must be recognized. But there is urgent need for a provision for those who do wish to continue in the day school for two years longer, in order to get a better preparation for the higher skilled trades, or who are ambitious enough to train for a foremanship.

A two years' industrial course, following the grammar grade, would accomplish the purpose of such a preparation and at the same time fill in the gap between 13 and 16 years of age before the boys enter upon any definite occupation. At 16 years of age trade schools should be established for specific trade education. Those trade schools would give most satisfaction which would interchange time between the shop and the school.

Oil Burning Melting Furnace

By H. A. Evans*

The furnace is made of sheet metal and structural steel, lined with fire brick with a hearth of dolomite.

California crude oil at 15 lbs. pressure and air at 3 lbs. are mixed and burned to melt down iron for castings. A reflected flame is used in a special burner. This is twice reversed over the short hearth to deliver more heat and can be adjusted to make the flame oxidizing or reducing.

Chemical analyses and physical strength tests are given to show results obtained in the furnace. The heat can be regulated to use it for a brass furnace and the consumption of fuel is low.

In a small jobbing foundry there is a necessity for a furnace in which a small heat of iron can be quickly obtained. Frequently an important iron casting is delayed, waiting for enough work to make a charge for the cupola. There are some revolving furnaces, principally used for brass work, in which it is claimed that iron can be melted, but it has been my experience that a satisfactory quality of iron cannot be obtained from these furnaces.

On the Pacific coast the cost of coke and coal is high, while the cost of fuel oil is low. On account of the high cost of coke numerous attempts have been made to use oil as a fuel in an ordinary cupola, but without success.

On account of high fuel cost in a cupola and the need of a furnace in which small heats of iron can quickly be obtain, I developed in 1906 an oil-burning furnace for this purpose, and this furnace has been in successful operation at the Mare Island navy yard since that time.

In Figs. 1, 2 and 3, is shown the construction of the furnace and the arrangement of the oil and air piping. As the furnace was originally experimental, scrap material was used as far as possible in order to reduce cost, and this will account for the patchwork shown in the drawings and photographs.

The framework is of plates, angle-irons and castings. The top and side walls are of the very best quality fire-brick and the hearth is of magnesite brick. In the furnace there is an inclined hearth and a collecting chamber for the molten metal. A charging door is provided both at the top and side. The flue is at the same end as the burners. A peep hole is provided at the same end, being fitted on a small box, to which air pressure is admitted, to prevent the flame from escaping or the peep box from becoming overheated.

The best results are obtained by operating the furnace with the oil at about 15 pounds pressure, and the air at 3 pounds. Satisfactory results, however, can be obtained with the fan blast pressure for atomizing and for combustion. California fuel oil of 14 to 20 gravity should be heated to a temperature of 120 degrees Fahrenheit.

A detail sketch of the burner that has been found most satisfactory is given in Fig. 4. Here *A* is the body, *B* the bonnet, *C* the oil pipe, *D* machine screws and *E* a rubber gasket.

*Naval constructor, U. S. navy.

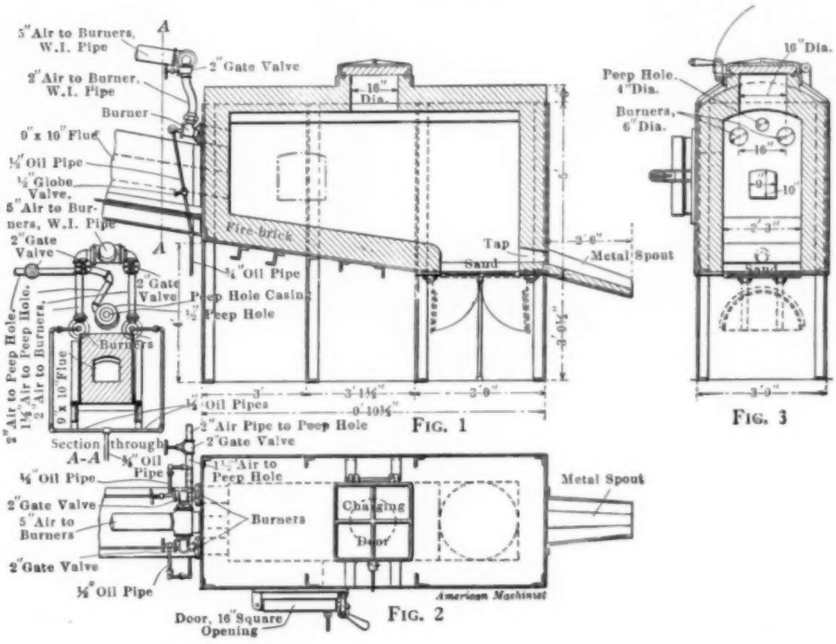


FIG. 1

FIG. 3

FIG. 2

DETAILS OF OIL-BURNING FURNACE FOR MELTING IRON OR BRASS

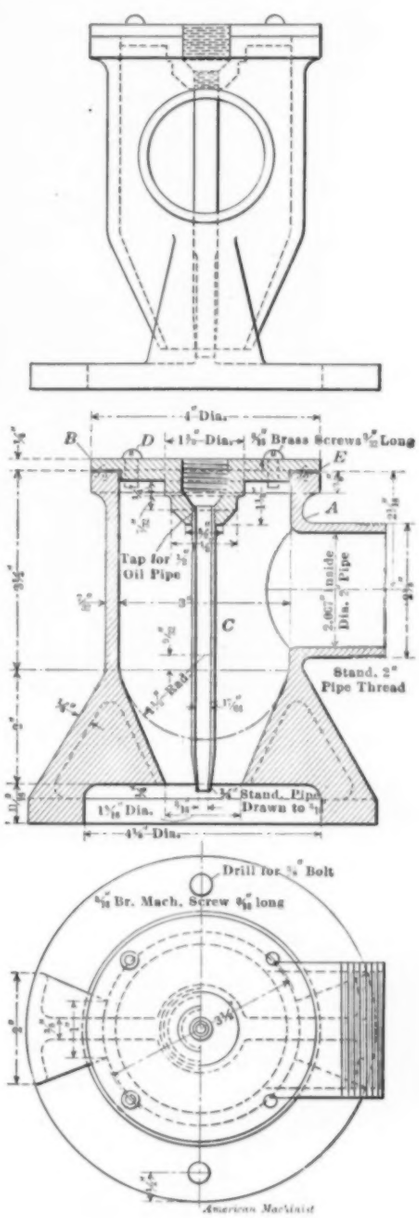


FIG. 4. DETAILS OF OIL BURNER

Operation of Furnace

The folding doors in the bottom of the collecting chamber are closed and the bottom covered with sand. The pig iron is placed on the hearth either through the side or top door. The burners are lighted, using oily waste. The top door is left open until the burners are well lighted and the furnace warmed up, and the door is then closed, the gases escaping through the flue.

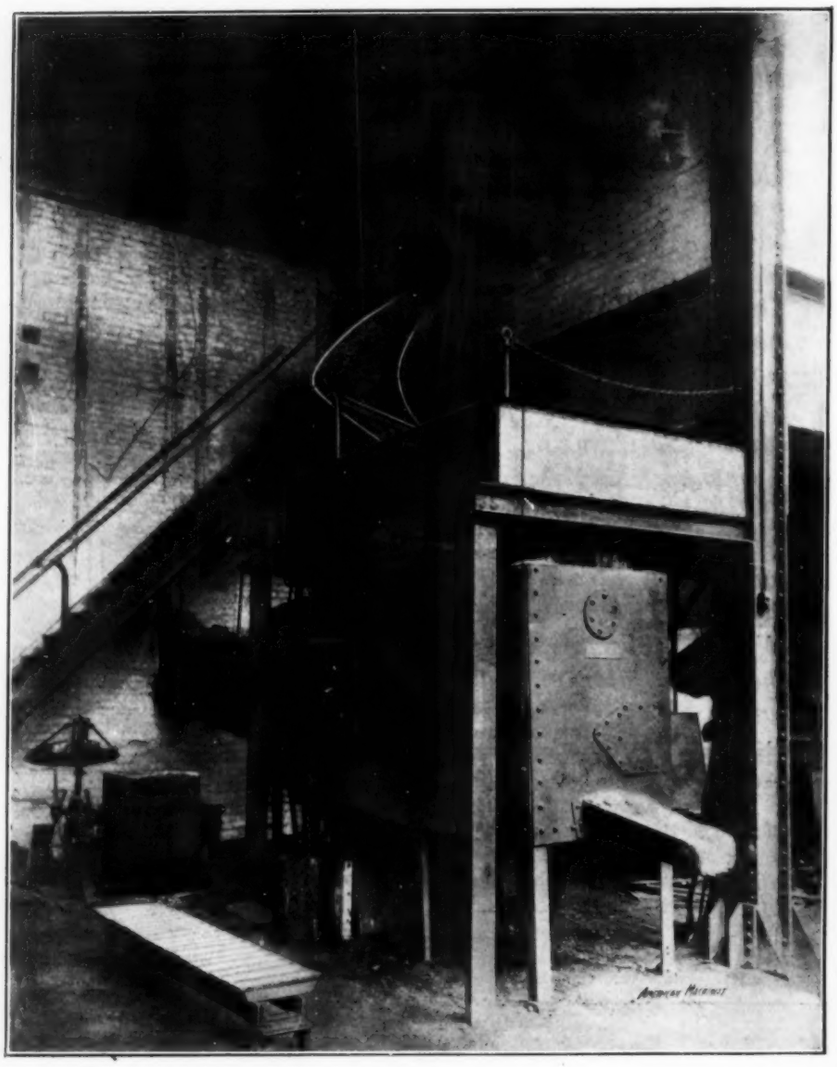


Fig. 5. The Furnace as Installed

The flame from the burners is so adjusted, by regulating the supply of blast and oil, that it strikes the end of the furnace farthest from the burner just above the collecting well, and then returns along the hearth to the flue. The burners are then further regulated to give a good combustion and the blast is made just sufficiently strong to draw out the flame to that length which will cause its hottest points to come in contact with the metal on the hearth, its oxidizing points to play above the same and its cooler parts to overlie the collecting well.

This regulation is obtained by observing the color of the flame through a small hole in the flue near the furnace, or the furnace itself can be observed through the peep hole. When the proper regulation is accomplished the hottest part is the hearth end, while the end where the metal is collected is at a lower temperature. The iron on the hearth melts and immediately flows down the incline to the collecting end. Here, owing to the character of the flame at this point, the temperature is not sufficiently high to burn the metal, but the temperature is high enough to insure hot metal for pouring.

The tapping off hole is kept open until the metal begins to run out and then stopped until sufficient metal has collected to tap off. When the charge on the hearth has been reduced by melting, the furnace can be recharged either through the side door or top door.

Advantages of Reflected Flame

By using a reflected flame, a relatively long flame is made to twice reverse a relatively short hearth, and thereby deliver more heat at the point needed than would be possible with a straight flame. Furthermore, by adjusting the flame as described, its oxidizing and reducing points can be brought to any place desired, and thereby effectually prevent the sulphur of the oil from entering the metal. Careful analysis extending over long periods shows that in no case has the sulphur content increased, and in some cases the sulphur in the metal has actually decreased after melting.

The regulation of the blast is important. If too little blast is used the hot part of the furnace is too near the collecting end, and the iron will be burned; and if too much blast is used, the furnace is cooled off and the flame is drawn out too long, thus causing the maximum temperature to be found in the flue or the stack. Again, if the furnace is too short with a given flame, the collecting end will be too hot and the metal will be burned. If the furnace is too long, the collecting end will be too cool and the metal will not run well.

Results Obtained

The first melt taken out of this type of furnace was successful. The first charge was 600 pounds of pig iron and it was hardly expected that satisfactory castings would be obtained at first, but excellent

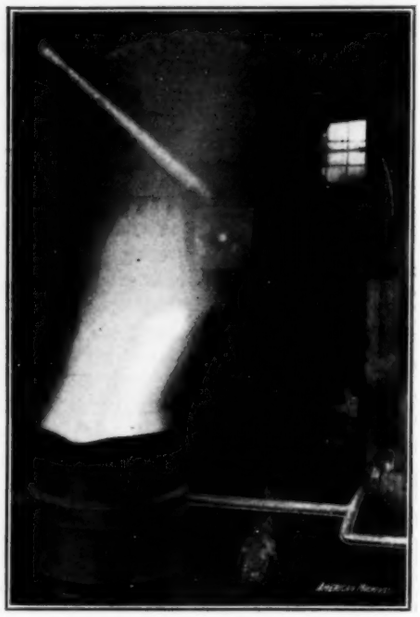


Fig. 6. Tapping Iron from the Furnace

small castings were made and a coupon taken from this melt showed a tensile strength of 26,000 pounds.

The data taken on the first melt are as follows:

Charge, 600 pounds pig iron; melted iron showed at spout 17 minutes after burner was lighted (furnace had previously been warmed up with a wood fire); 300 pounds of metal tapped 25 minutes later; 275 pounds of metal tapped 10 minutes later; bottom dropped;

tensile strength of coupon taken from heat, 26,000 pounds per square inch.

Since that time many iron heats have been taken and a large number of physical tests and chemical analyses have been made and these show a uniformly satisfactory product.

The two analyses given below of pig charged and resulting metal are typical of the results obtained:

	Pig Charged (Egling-ton).	Resulting Metal.
Graphite	3.2 %	2.81%
Combined carbon	0.82	0.33
Silicon	2.5	2.23
Phosphorus	1.10	1.10
Sulphur	trace	none
Manganese	0.31	0.92

Tensile strength, 24,342 pounds.

Graphite	3.2 %	3.41%
Total carbon	3.52	3.85
Silicon	2.5	2.19
Phosphorus	1.10	1.04
Sulphur	trace	none
Manganese	0.31	0.75

Tensile strength, 21,273 pounds.

Consumption of Oil

Eighteen hundred pounds of pig iron were melted in this furnace with a consumption of 85 gallons of 15 gravity fuel oil, this being the total amount required when starting with cold furnace. A smaller charge will require relatively more oil than a charge of this size, as the furnace itself must be heated. With charges from 1500 to 2600 pounds, the consumption is from 45 to 50 gallons of oil per thousand pounds of iron melted. With oil at 2 cents a gallon, the fuel cost for this melt is $1.70. With coke at $13.50 per ton (present price on the Pacific coast), the fuel cost for this melt in a cupola will be about $3.60.

Use as a Brass Furnace

While the furnace was designed primarily for taking small heats of iron, it has been found most useful as a large brass furnace, particularly for melting large quantities of scrap brass, and it has been extensively used for this purpose. Large quantities of scrap brass accumulate in the repair work at navy yards and while some of this scrap can be used direct on certain work, it is found desirable and necessary to melt much of it in quantities and pour into brass pigs.

Large quantities of old condenser tubes accumulate and it has been previously found difficult to satisfactorily use this scrap. There is a great deal of dirt on the tubes and on account of their thinness and the large volume of space occupied, it has been difficult to melt this scrap at low cost. Moreover, the zinc loss in melting has been large. The furnace described has been found well suited for this use.

In melting condenser tubes, the furnace should be heated to a high temperature before charging. If the furnace is charged before heating, the tubes will settle as heated and the coating of dirt and deposit from the tubes will make it difficult to melt. If the furnace is first heated to a high temperature and then charged from the top door, melting will take place very rapidly.

In Fig. 5 is shown the furnace as it is set up in the foundry. A chute leads from the charging platform to the top charging door and the scrap is carried to the furnace through this chute. By this means the furnace can be rapidly charged at a low labor cost. A jib crane swings over the furnace to handle the materials and metals with.

In Fig. 6 is shown the furnace as a charge of iron is being tapped from it after being melted. The peep hole mentioned farther back in the article can be plainly seen in the front of the furnace. Another one was later placed on the back of the furnace near the valves so the oil and blast could be regulated more easily.

It has been found that the zinc loss in melting is not excessive. The usual composition of condenser tubes, when new, is copper 70 per cent. and zinc 30 per cent.

Typical analyses and physical tests of the metal contained from the old condenser tubes, when melted, follow:

	Tensile Strength.	Elongation in 5 Inches.
Coupon first tap from heat	26,530 lb.	33.6%
Coupon later tap from heat	24,671 lb.	29.6%

Analysis.

Tin	0.62%
Lead	0.61%
Copper	74.18%
Zinc	24.59%

Coupon first tap from heat	25,487 lb.	31.2%
Coupon later tap from heat	22,349 lb.	24.4%

Analysis.

Tin	0.76%
Lead	0.80%
Copper	76.32%
Zinc	22.12%

In addition to the melting of scrap, the furnace has been used on all classes of brass work with excellent results.

Drilling Tests of a Plain Radial

The following table shows some interesting tests on a Bickford No. 2 plain radial, drilling on July 26, 1910.

This shows the power absorbed in drilling in cast iron. While some of these tests consume as much as 16.5 horsepower, the makers recommend that the motor be limited to 7½ horsepower, as this can be counted on for an overload of about 50 per cent., which permits using a 0.030-inch feed for all sizes of drills up to and including 2½ inches, at a cutting speed of 70 feet per minute.

A careful study of this table will show the speed and feeds which accomplish the most work with the least power. It will be noted in most cases that doubling the feed, from 0.015 to 0.030 inch, only increases the power consumption about 50 per cent. While power consumption is not the only item to be considered it should be remembered that it also means wear on the machine.

	Speed.		Feed per Revolution.					Speed.		Feed per Revolution.			
Size.	Revs.	Feet.	0.015	0.020	0.025	0.030	Size.	Revs.	Feet.	0.015	0.020	0.025	0.030
1	172	45.1	4.1	4.4	4.9	5.2	2	97	50.5	6.1	7.0	7.4	9.3
1	194	50.8	4.4	4.8	5.4	5.9	2	107	55.6	6.4	7.4	7.9	9.9
1	214	56.0	5.0	5.4	5.8	6.4	2	121	63.4	6.7	8.0	8.6	10.2
1	238	62.3	5.7	6.0	6.5	7.2	2	134	70.1	6.4	7.1	8.3	10.6
1	268	70.2	6.4	6.8	7.3	8.2	2	155	81.2	7.2	8.3	9.8	12.0
1	306	80.0	7.4	7.8	8.4	9.5	2	172	90.2	7.8	9.3	11.1	13.2
							2	194	102.0	8.6	10.6	12.7	14.7
1¼	172	56.4	5.3	5.9	6.6	7.1							
1¼	194	63.4	5.9	6.6	7.3	7.9	2¼	121	71.1	8.4	9.3	10.9	11.0
1¼	214	70.0	6.4	7.2	7.9	8.7	2¼	134	78.9	7.5	8.1	9.7	9.9
1¼	238	77.8	7.0	7.9	8.7	9.7	2¼	153	90.1	8.2	9.3	11.3	11.9
1¼	268	87.6	7.8	8.7	9.7	11.0	2¼	178	105.0	9.2	10.9	13.3	14.7
1¼	306	100.0	8.9	9.8	10.9	12.5							
							2½	107	70.0	7.4	10.1	10.4	11.2
1½	155	60.8	5.1	6.3	7.7	8.1	2½	121	79.2	8.7	11.2	11.8	13.0
1½	172	67.5	5.6	6.9	8.4	8.8	2½	134	87.6	7.9	10.0	10.4	11.6
1½	194	76.2	6.3	7.7	9.3	9.8	2½	153	100.0	9.8	10.9	11.6	13.6
1½	214	84.0	7.0	8.4	10.1	10.7							
1½	238	93.4	7.8	9.2	11.1	11.8	2¾	97	69.9	8.5	10.3	11.8	13.5
1½	268	105.0	8.7	10.3	12.4	13.1	2¾	107	77.0	9.6	11.4	13.2	14.7
							2¾	121	87.1	11.1	13.1	15.2	16.3
1¾	134	61.2	5.5	6.9	7.3	8.9	2¾	134	96.5	9.9	11.4	13.3	14.9
1¾	155	70.9	6.6	7.9	8.8	10.3							
1¾	172	78.8	7.4	8.7	9.9	11.0	3	89	70.0	8.9	10.5	12.2	13.9
1¾	194	88.8	8.5	9.7	11.4	12.8	3	97	76.4	9.4	11.1	12.7	14.3
1¾	214	98.0	9.4	10.6	12.7	14.1	3	107	84.0	11.1	12.2	13.7	14.7
1¾	238	110.0	10.6	11.7	14.3	16.5	3	121	95.0	10.9	12.3	13.8	15.3

POWER CONSUMED IN DRILLING CAST IRON.

Pickling Castings and Dips Used

Editorial Correspondence

Various pickling baths for different kinds of work. Acids and recipes for obtaining different kinds of finish on work.

As there are many places where castings could be pickled to advantage where this is not done, it is probably safe to assume that its advantages and operation are not thoroughly understood.

Cast iron is poured at such high temperature that it is almost impossible to prevent some of the sand from the molds adhering to the castings regardless of the facing material which has been used, and in many cases a scale is formed by the union of iron oxide and sand. Even when fairly free from sand the castings are very apt to be covered by the scale of black oxide, which is very hard to cut, and the sand which it contains acts as an abrasive and grinds away the edge of the cutting tool. In many classes of work it becomes absolutely necessary to remove this before the piece is machined.

Sulphuric acid has been very largely used for this purpose and muriatic acid is sometimes substituted but not generally considered as good as sulphuric. The objection to sulphuric acid seems to be that it eats away the iron around and underneath the scales of sand instead of dissolving these scales and it also has a tendency to rust the castings. It is particularly objectionable where castings are to be plated, as the rust forms under the plating and causes it to flake off.

Hydrofluoric Acid

Some foundrymen are beginning to use hydrofluoric acid for the pickling baths, claiming that this dissolves the sand itself and attacks the iron very slowly, this being one of the reasons that hydrofluoric acid cannot be safely placed in glass bottles.

It is recommended that hydrofluoric acid be used in 10, 15 or 20 parts of water, according to conditions. The weak solution requires a longer immersion in the bath but generally gives the best results. It is advisable to have all loose sand removed by brushing or tumbling, as this preserves the strength of the solution, one pound of sand doing more to neutralize the solution than several hundred pounds of cast iron.

Tanks can be made of oak well lined with asphaltum, and the dipping baskets, where they are necessary, should be of hard rubber, wood fiber or of wood, and should have no metal fastenings whatever. When large quantities of work are to be pickled the time of immersion can be shortened by heating the bath up to about 150 degrees Fahrenheit with a steam pipe.

There should be three tanks, the first containing the pickle, the next of clear water and the third for hot lime water. The latter should be very weak, a mixture of 5 pounds of lime to the barrel being sufficient, and it should be kept hot by a steam coil in the bottom of the tank.

Always Add Acid to Water Slowly

It is very important to remember in mixing acids that the acids should always be added to the water slowly and with constant stirring. *Never add water to acid.* The reason for this is that the mixing is always attended with heat and if the water be poured into the acid, the resulting heat would convert the water into steam which would blow drops of the acid about the room and cause serious burns.

In case any of the acid comes in contact with the flesh the injured part should be covered at once with lime water or ammonia.

Bottles of each of these should always be kept in a convenient place. Plain water will relieve the pain but the acid should be neutralized as quickly as possible.

The hands should be kept out of the pickle and rubber gloves used when it becomes necessary to handle the dipping baskets or the metal which has been pickled.

The following formulas for different baths or dips will be found useful:

Those who attend the pickling of castings should wear wooden shoes in order to protect them from colds and rheumatism. A modified form of the old Dutch shoe, having a wooden sole about two inches thick and upper of heavy leather makes about the best protection possible.

Special for Electro-galvanizing

For preparing work for electro-galvanizing the following can be used with advantage, but for no other solution except perhaps copper: Add to the dilute acid half pound of sheet zinc to each 25 gallons of solution, adding additional amount occasionally as it works out.

Bright Dip for Iron

Work that has been pickled in the ordinary way to remove sand and scale and then dried, usually has a dull black appearance. If the work is to be polished, the black will be removed and the color restored in the polishing process; but if it is to be plated, or if it is to be left with parts of iron showing, the work should be run through the bright dip. This will bring it out white, improving the appearance and tending to make it take on a white deposit if it is to be nickeled. This dip is composed of,

Hydrofluoric acid	24 ounces
Nitric acid	10 ounces
Metallic zinc	2 ounces
Water	2 gallons

Work that is to be dipped should be strung on copper wire, and swirled around in the solution for a few seconds, rinsed in cold and then very hot water and dried in sawdust. Articles should not be allowed to stay in the dip any time, as they would be spoiled and the solution ruined.

Satin-finish Dips

Brass work requiring a satin finish may be dipped for a few seconds into a mixture consisting of:

Hydrofluoric acid	1 part
Water	3 parts

then dried and run through the bright dip to give it a luster. If not satined enough the operation may be repeated.

A Bright Dip for Copper, Brass, Bronze or German Silver

Hydrofluoric acid	4 quarts.
Nitric acid	3 quarts.
Common salt	Small handful.

Another Satin Dip

Hydrofluoric acid	2 parts.
Nitric acid	1 part.
Muriatic acid	½ part.
Water	5 parts.

After which the work may be rinsed, dried and run through the bright dip, if necessary. Still another satin dip is:

Hydrofluoric acid	2 parts.
Nitric acid	1 part.
Water	10 parts.

Finishes and Dips

An ormolu finish is imitated twenty-two or twenty-four karat gold color or yellow brass. This finish is used extensively on gas fixtures, furniture trimmings, lamps, clocks and bronzes. The oromolu dip may be used on bronze oxide or copper, and produces a very rich, soft, velvety finish, which is handsome when lacquered.

The possibility of utilizing the peat deposits of the United States for fuel is attracting increased attention. A recent writer says that a good tract of peat of 28 acres in extent and averaging 9 feet in depth, on proper treatment, should yield 50,000 tons of peat fuel, or enough to support a community of 100 families for 35 years, if the average consumption of each family were as much as 20 tons a year.

	Silicon.	Sulphur.	Phos.	Mang.	Comb. Carb.	Total. Carb.
Piano Plates:						
	2.00%	low	0.40%	0.60%		
Sug.	2.00–2.25	und. 0.07	0.40–0.60	0.60–0.80		
Pillow Blocks:						
	1.60%	0.040%	0.55%	0.55%	0.30%	3.50%
Sug.	1.50–1.75	und. 0.08	0.40–0.50	0.60–0.80		
Pipe:						
	2.00%	0.060%	0.60%	0.60%		
	2.00	0.060	1.00	0.60		
Sug.	1.50–2.00	und. 0.10	0.50–0.80	0.60–0.80		
Pipe Fittings:						
	2.88%		0.41%	1.10%		
	1.70	0.058	0.50	0.73	1.16	4.18
	2.51	0.110	0.62	0.41	0.24	3.18
Sug.	1.75–2.50	und. 0.08	0.50–0.80	0.60–0.80		
Pipe Fittings for Superheated Steam Lines:						
	1.72%	0.085%	0.89%	0.48%	0.17%	2.45%
	1.40–1.60	0.06–0.09	0.20–0.40	0.45–0.75		3.00–3.25
Sug.	1.50–1.75	und. 0.08	0.20–0.40	0.70–0.90		low
Piston Rings:						
	1.35%			0.40%		
	1.60	0.08%	1.15%	0.35	0.60%	
	1.50–2.00	0.06–0.08	0.40–0.60	0.45–0.60	0.45–0.55	3.50
Sug.	1.50–2.00	und. 0.08	0.30–0.50	0.40–0.60		low
Plow Points, Chilled:						
	1.20–1.40%		low			low
	1.20	0.090%	0.30%	0.50%	1.20%	3.20%
	0.75	0.090	0.30	0.30	3.00	3.20
	1.20	0.080	0.30	1.25		3.50
Sug.	0.75–1.25	und. 0.08	0.20–0.30	0.80–1.0		
Propeller Wheels:						
	1.15%		0.32%	0.51%	0.60%	
	1.40	low	0.20	0.40		
Sug.	1.00–1.75	und. 0.10%	0.20–0.40	0.60–1.0		low
Pulleys, Heavy:						
	1.75%	0.040%	0.55%	0.55%	0.30%	3.75%
	2.40	0.060	0.60	0.60		3.75
Sug.	1.75–2.25	und. 0.09	0.50–0.70	0.60–0.80		
Pulleys, Light:						
	2.20–2.80%	und. 0.08%	und. 0.70%	und. 0.70%		
	2.40	und. 0.08	0.95	0.70		
	2.72	0.040	0.50	0.66		
	2.52	0.075	0.77	0.68		3.37%
	3.35	0.089	0.70	0.47		3.42
	2.25	0.040	0.55	0.55	0.30	3.57
	2.15	0.080	0.70	0.60	0.40	3.55
Sug.	2.25–2.75	und. 0.08	0.60–0.80	0.50–0.70		
Pumps, Hand:						
	2.30–2.75%	und. 0.08%	0.60–1.0%	0.30–0.50%		
Sug.	2.00–2.25	und. 0.08	0.60–0.80	0.50–0.70		
Radiators:						
	2.15%	low	0.80%	0.45%	0.50%	3.50%
	2.45	0.104%	0.44	0.40	0.35	3.40
Sug.	2.00–2.25	und. 0.08	0.60–0.80	0.50–0.70	0.50–0.60	
Railroad Castings:						
	2.20–2.80%	und. 0.08%	und. 0.70%	und. 0.70%		
	1.40–1.80	0.06–0.08	0.50–0.80	0.45–0.60	0.40–0.65%	3.50%
	2.25	0.050	0.60	0.75		
	1.75	0.070	0.85	0.60		
Sug.	1.50–2.25	und. 0.08	0.40–0.60	0.60–0.80		
Rolls, Chilled:						
	0.50–1.00%	0.01–0.06%	0.20–0.80%	0.15–1.5%	2.60–3.25%	
	0.80	0.100	0.88	0.16	0.91	2.84%
	0.71	0.058	0.54	0.39	1.38	3.00
	0.65	0.050	0.25	1.50	0.63	3.50
Sug.	0.60–0.80	0.06–0.08	0.20–0.40	1.0–1.2		3.00–3.25
Rolls, Unchilled (sand cast):						
	0.75%	0.030%	0.25%	0.66%	1.20%	4.10%

	Silicon.	Sulphur.	Phos.	Mang.	Comb. Carb.	Total. Carb.
Scales:						
	1.67%		1.92%	1.90%		
	2.12		0.61	0.80		
	1.70		0.63	1.60		
Sug.	2.00–2.30	und. 0.08	0.60–1.0	0.50–0.70		
Slag Car Castings:						
	1.76%	0.075%	0.63%	0.79%	0.56%	3.68%
	2.00	0.030	0.70			
Sug.	1.75–2.00	und. 0.07	und. 0.30	0.70–0.90		
Soil Pipe and Fittings:						
	2.00%	0.060%	1.00%	0.60%		
Sug.	1.75–2.25	und. 0.09	0.50–0.80	0.60–0.80		
Steam Cylinders, Heavy:						
	1.41%	0.092%	0.38%	0.39%		
	0.95	0.100	0.30	0.90	0.80%	3.40%
	1.10	0.136	0.43	0.33	0.99	3.30
	1.00	0.080	0.20–0.30	1.00	0.75	3.00
	1.35–1.50	0.080	0.50	0.75		3.65
	1.20–1.40	0.04–0.08	0.40–0.50	0.70–0.80	0.70–0.80	3.00–3.20
	0.90–1.20	0.09–0.12	0.20–0.40	0.70–0.90		und. 3.50
Sug.	1.00–1.25	und. 0.10	0.20–0.40	0.80–1.0		low
Steam Cylinders, Medium:						
	1.66%	0.065%	0.70%	0.90%		
	1.60	0.063	0.72	0.85		
	1.70	0.070	0.70	0.75		
	1.70	0.075	0.60	0.92		3.50%
	1.40–2.00	0.085	0.70	0.30–0.70		
	1.50–2.00	und. 0.08	0.35–0.60	0.50–0.80		
	1.40–1.60	und. 0.09	0.40–0.90	0.40–0.90		
	1.50–1.65	0.080	0.60	0.60–0.70		
	1.50–1.80	0.070	0.43	0.76		
	1.85%	0.080%	0.60%	0.50–0.60%	0.50%	3.25–3.50%
	1.75	0.100	0.65	0.55		3.40–3.55
	1.32	0.136	0.43	0.33	0.99	3.30
	1.12	0.085	0.40	0.70	0.70	3.50
	2.00	0.100	0.50	0.70	0.40	3.50
	2.00	0.070	0.30	0.60		
	1.50	0.070	0.75	0.70		3.50
	1.59	0.109	0.60	0.38		3.34
	1.86		0.29	0.55	0.52	
	1.90	0.074	0.50	0.65		
	1.56	0.061	0.45	0.78		
Sug.	1.25–1.75	und. 0.09	0.30–0.50	0.70–0.90		
Stove Plate:						
	2.90%		0.73%	1.40%		
	2.59	0.072%	0.62	0.37	0.35%	3.30 %
	3.19	0.084	1.16	0.38	0.33	3.41
	2.75	0.050	1.00	0.80	0.18	3.38
	2.79	0.077	1.40	0.32	0.20	3.22
	2.51	0.110	0.62	0.41	0.24	3.18
	2.76	0.071	0.63	0.63	0.37	3.50
	2.76	0.084	0.65	0.54		
	2.50	0.060	1.00	0.60		
	2.60	0.050	0.60	0.60		
	2.50–3.00	und. 0.10	0.60–0.80	0.40–0.60		3.00–4.00
Sug.	2.25–2.75	und. 0.08	0.60–0.90	0.60–0.80		
Valves, Large:						
	1.20–1.50%	und. 0.09%	0.35–0.60%	0.50–0.80%		
	1.00	0.100	0.50	0.90		
	1.67		0.26	0.45		0.69%
Sug.	1.25–1.75	und. 0.09	0.20–0.40	0.80–1.0		
Valves, Small:						
	1.70%	0.058%	0.50%	0.74%	1.16%	4.18%
	2.23	0.075	0.67	0.67		
Sug.	1.75–2.25	und. 0.08	0.30–0.50	0.60–0.80		low
Water Heaters:						
	2.15%	0.050%	0.40%	0.50%		
Sug.	2.00–2.25	und. 0.08	0.30–0.50	0.60–0.80		
Wheels, Large:						
	2.10%	0.040%	0.40%	0.70%		
Sug.	1.50–2.00	und. 0.09	0.30–0.40	0.60–0.80		
Wheels, Small:						
	2.10%	0.050%	0.40%	0.50%		
	1.60	0.083	0.60	0.39		
Sug.	1.75–2.00	und. 0.08	0.40–0.50	0.50–0.70		
White Iron Castings:						
	0.50%	0.150%	0.20%	0.17%	2.90%	
	0.90	0.250	0.70	0.50		2.50

CHEMICAL ANALYSES OF CAST IRON FOR VARIOUS PURPOSES.—III.

Slide Rule in Screw Machine Work

By George D. Hayden*

While many people regard the slide rule as a mild mystery, many others, understanding its principle, regard its results as too inaccurate for careful work.

For the calculation of screw-machine operations, gears, cams, etc., accurate results can be easily obtained in a short time, which, by long-hand methods, would require hours of figuring.

*Chief draftsman, Davenport Machine Company.

Some people look at the slide rule as an interesting novelty, and after acquainting themselves with the principle thereof and doing a few examples to satisfy their curiosity, lay it aside as a device not sufficiently accurate to be of much practical use.

I have worked many years over a drawing board and would as soon think of making a drawing without a lead pencil as to get along with no slide rule. The instruction book usually given with the rule contains all kinds of stunts, short cuts and examples, many of them one never heard of in practice; and to look through this book with its queer signs and formulas is very apt to discourage a mechanic who has had little or no training in higher mathematics.

In machine work, such as designing or working on such machines as one will find in a machine shop with speed and feed cones, gear boxes, lathe and milling-machine leads, screw-machine cam work and the like, the slide rule is an efficient, and very decided, time and brain-work saver, if used properly. In this line of work the rule is used on multiplication and division, usually of fractions in the form of ratio and proportion. In gear work, where the number of teeth is used as the unit, the use of the rule is simplified, because only whole numbers are involved.

Using the rule I find it better to use the two top scales *A* and *B*. If the slide projects over one or the other ends, you can read your result from the center and end not projecting; further, it is easier to consider scale *A* as the numerator and scale *B* as denominator of a fraction, as it is then always right side up.

Example 1

As a simple example, take the case of laying out an order of operation, and the cams, for a Brown & Sharpe automatic screw-machine job. The conditions may be as shown in the table.

The sum of column I, in the table, should foot up to some figure, as given in Brown & Sharpe treatise; likewise the number of revolutions necessary to revolve turret, etc. The slide rule here will be used as follows:

		Column I. Revolutions of Spindle.	Column II. 100ths of Cam.
1st Operation.	Turn with hollow mill 0.965 long with feed of 0.012 per revolution	81	16½
	Revolve turret	15	3
2d Operation.	Finish turn box tool 0.775 @ 0.008	97	20
	Revolve turret	15	3
3d Operation.	Thread 20 threads on and 20 off	40	8
	Revolve turret	15	3
4th Operation.	Form 0.042 @ 0.0005	84	17
5th Operation.	Cut off 0.325 @ 0.0025	130	26½
	Feed stock	15	3
		492	100

TABLE OF OPERATIONS IN EXAMPLE 1.

The first operation says, turn 0.965 at 0.012; so set the runner on 965 on scale *A* (found near the middle) and under it set 12, found on scale *B* (near the middle). This brings the slide projecting over the left end, but the result will be found on *A* over the 10 and over the 100 of *B* scale, giving between 80 and 81. If the runner is set on 965, found at the right end of the scale *A*, with the same 12 placed under it, the same result will be found on *A* over 1 and 10 of *B* scale. The slide here projects over the right end of scale. Again, if the runner is kept in this last position and 12 on the left end of scale *B* set under 965, this brings the slide almost out of rule at the right end, but the same result, 80 to 81, will be found over 1. It is better, of course, to use the scale in the center, rather than at the extreme ends.

Take the second operation; place runner on 775 of scale *A*, under it set 8 of scale *B* and read result, 97, in two places, over 10 and 100.

Take fourth operation. Set the runner on 42 at scale *A;* under it set 5 of scale *B*, and result, 84, in two places; over 10 and 100.

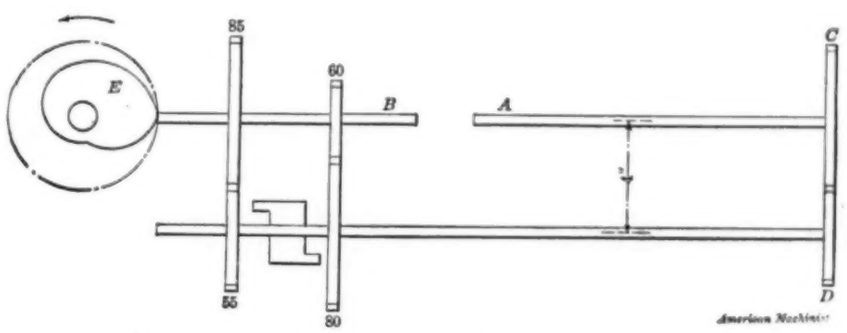
Take fifth operation. Set the runner on 325 at scale *A;* under it set 25 of scale *B*, and read result, 130, in two places; over 1 and 10.

After completing and adding up column I, of the table, the next step is to reduce this column to 100ths, as shown in column II. This calculation shows in a measure how convenient the slide rule is, as all the results can be made with one setting thus: Set runner on 492 of scale *A*, of the rule; under it set 10 of scale *B*, and read results as follows, starting with 81 of first operation.

Under 81 read 16½ nearly
Under 15 read 3 nearly
Under 97 read 20 nearly
Under 40 read 8 nearly
Under 84 read 17 nearly
Under 130 read 26½ nearly

If the column II foots up to 100, we know that the readings are correct.

The next step of the slide-rule use is after the lobes of the cams are laid out.



CONDITIONS OF EXAMPLE 2

For the first lobe we have rise of 0.965 in $\frac{16\frac{1}{2}}{100}$; second lobe we have rise of 0.775 in $\frac{20}{100}$, etc. In some cases, it depends upon how the cam is to be milled; we would like to know what the whole

rise would be; that is, the cam has a rise of 0.965 in $\frac{16\frac{1}{2}}{100}$, how much rise will cam have in whole, or $\frac{100}{100}$? Set runner on 0.965 of *A* scale of rule; under it set 16½ of *B* scale and read result on *A*, 5.85, in two places, over 10 and 100.

EXAMPLE 2

The following example shows very clearly how convenient the slide rule is. Let the reader calculate the requirements without one and I think he will be mighty glad when the job is done.

Fig. 1 shows the conditions which were fixed. *A* represents a live spindle, *B* a spindle for revolving a die, *E* a cam for advancing and returning die spindle *B*, cam *E* to be used for cutting both right-hand and left-hand threads. To get a slow cutting speed for die, the spindle had to revolve in the same direction as *A* but slower, preferably three-quarters of *A*, making effective one-quarter of *A* for cutting speed. The die is run off by speeding it up faster than live spindle *A*. For left-hand threads the operation is reversed; *C* and *D* are change gears that are to be determined with center distance fixed to four inches. Using a 12-pitch gear, the sum of teeth will be 96. For cutting a right-hand thread, what change gears *c* and *d* will we use to fulfil the above conditions?

Thus

$$\frac{x}{1} \times \frac{55}{85} = \frac{3}{4}, \text{ or } \frac{55x}{85} = \frac{3}{4}, \text{ or } 220x = 255, \text{ or}$$

$$x = \frac{255}{220}.$$

Consulting our slide rule, set 220 of *B* under 255 of *A* and look for a pair of gears of this ratio, whose sum equals 96. Nearest ratio = $\frac{52}{44}$. Using these gears and multiplying through the train, we have $\frac{52}{44} \times \frac{55}{85}$ = according to rule, $\frac{3.25}{4.25}$.

To do this by slide rule, place under 52 of scale *A* the 44 of scale *B*. Next, place runner on 55 of *B* scale, then shift the *B* scale, placing 85 on line of runner and from this ratio find the above result; 3.25 represents turns the die spindle makes while live spindle makes 4.25. That is, it takes 4.25 turns of the live spindle to cut one thread, die going on.

For the die running off, we have

$$\frac{52}{44} \times \frac{80}{80} = \text{according to rule, } \frac{2.75}{1.75}.$$

That is, die spindle makes 2.75 revolutions while live spindle makes 1.75, or die runs off one thread while live spindle turns 1.75 times. The sum of the spindle turns for the die to run on and off equals 4.25 plus 1.75, or 6. That is, if a job is right hand and has 10 threads on it, 60 turns of spindle will be necessary to allow die to run on and off.

For left-hand threads it is important that the ratio between the running off and on be the same as for right-hand threads, or $\frac{4.25}{1.75}$, in order that the high point of cam *E*, the reverse or change, will answer for both hands. There is no way that I know of to arrive at the proper change gears directly and obtain this result, so it becomes a matter of cut and try. If we should use the same change gears, but reverse them, they would give us results as follows:

$\frac{44}{52} \times \frac{80}{80}$ = according to slide rule,

$\frac{8.9 \text{ die}}{7.9 \text{ spindle}}$, running on;

$\frac{44}{52} \times \frac{85}{55}$ = according to slide rule,

$\frac{1.22 \text{ die}}{2.22 \text{ spindle}}$, running off.

The sum of the spindle turns to cut a left-hand thread will thus be 7.9 plus 2.22, or 10.12. This ratio $\frac{7.9}{2.22}$ will not answer, because it is not equal to $\frac{4.25}{1.75}$ and therefore cannot use same cam *E*; and again, the sum 10.12 means too many turns of spindle. Although the cutting speed is slower, it is rather too slow. We would like to have 6, just as for right hand, but we cannot have equal number of revolutions and equal ratio too. We choose the latter, as being more important.

According to last result, the driver change gear must be larger and from the slide rule we select $\frac{51}{61}$, whose sum is 96; these give us

$\frac{51}{61} \times \frac{80}{80}$ = according to rule, $\frac{6.7 \text{ die}}{5.7 \text{ spindle}}$, running on;

$\frac{51}{61} \times \frac{85}{55}$ = according to rule, $\frac{1.33 \text{ die}}{2.33 \text{ spindle}}$, running off.

This ratio $\frac{5.7}{2.33}$ is very near $\frac{4.25}{1.75}$, and the sum is 8.03. This result looks very good, but we have to allow eight turns of spindle for each left-hand thread.

We will now try the next larger size gears and observe the result:

$\frac{46}{50} \times \frac{80}{80}$ = according to rule, $\frac{5.45 \text{ die}}{4.45 \text{ spindle}}$, running on;

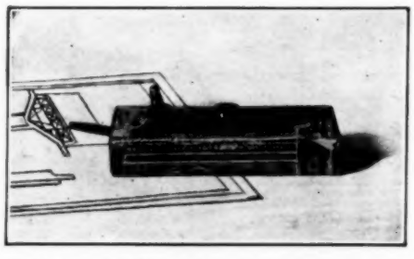
$\frac{46}{50} \times \frac{85}{55}$ = according to rule, $\frac{1.46 \text{ die}}{2.46 \text{ spindle}}$, running off.

The sum of the spindle turns in this case is 6.91, which approaches nearer to what we desire, but the ratio $\frac{4.45}{2.46}$ is now too much off the other way, more so than in the first case. So the gears $\frac{52}{44}$ for right-hand threads and gears $\frac{44}{52}$ for left-hand threads are best suited to fulfil the conditions. The high point on cam *E* will be as $\frac{4.25}{1.75}$ is to $\frac{x}{y}$, the sum of *x* and *y* to equal 100. Our slide rule gives us $\frac{71}{29}$, which is near enough.

A Firm Base for the Ink Bottle

BY C. L. CARMAN

Among several "kinks" that have been found to work out well in a temporary drafting room of which the writer was at one time in charge, was the method shown in the illustration of taking care of that otherwise troublesome "imp," the drawing-ink bottle. As will be seen by the illustration, a cigar box is the main thing, the size ordinarily used for 25 cigars is just right. A hole, large enough to pass the neck of the one-ounce bottle of drawing ink like the Higgins, is cut in the center of the cigar-box lid, and another hole large enough to receive the cork stopper is cut about two inches from it. A ⅜-inch hole is also cut in the end of the box for the penholder. The ink bottle is then placed in the box, the lid tacked down permanently (the writer used ordinary pins), with the neck of the bottle projecting through the central hole, and the thing is ready for business. The



HOLDING DOWN THE INK BOTTLE

bottle can't tip over in the box; the box has base enough to stay right side up, and as a matter of fact, not a single instance of spilled ink from these affairs is recalled in ten years' use.

When using ink frequently, as when writing in notes, or inking in a title, the cork can be placed in the other hole, as shown by the illustration, where it is not only safe and handy, but the quill is protected from dirt.

Washing out and refilling the bottle can be readily accomplished without removing the bottle from the box, but if desired, the lid is easily raised, if ordinary pins are used to secure it in the first place.

This arrangement has been found to be so handy, safe and altogether satisfactory that the writer believes it deserves a place in the equipment of more pretentious drafting rooms and it is therefore offered to such readers of the AMERICAN MACHINIST as may be dissatisfied with the method of using the ink bottle as a paper weight with the usual consequences.

Molding a Steam Turbine Cylinder

Special Correspondence

How the cores are prepared, finished and rammed, and the cores made up.

Method of finishing the mold, pouring and casting the cylinder.

While practically every piece of heavy machinery is principally made of cast iron or steel, the character of the metal and the care used in making the parts depends to a large extent upon the uses to which they are to be put. Some manufacturers, however, have evolved a much better product than others for similar work. Due to the character of the service that it performs and the shape necessary, it is essential that only the very best of materials and excellence of handling be employed in the making of a steam-turbine cylinder.

The turbine cylinder is subject to varying degrees of heat, which in itself imposes an extra burden on the metal. It must also be more or less self supporting in addition to its ability to stand an internal pressure. It is, therefore, important that the material shall be strong enough to withstand both the pressure and the other strains induced. These considerations require not only material of extremely good quality, but a design and casting method that will reduce the internal strains to a minimum. To those who are interested in the subject it may be of value to learn of the practice followed in the foundry of Allis-Chalmers company, which is one of the large builders of turbines.

The pattern and core boxes for a turbine are brought to the foundry from the pattern-storage room. The pattern and main cylinder core box are sent to the turbine-molding section and the other core boxes to the core room. Accompanying the pattern is a special molding board that is provided with sockets into which pins fit that are on the pattern. The pattern is molded in the cope and the main core in the drag of a flask. By the use of this special mold board, and the pins and sockets, the two are brought into correct relation with each other.

Preparing the Cope

The turbine cylinder is made in two sections and the pattern of a half cylinder is placed on its mold board. The cope flask is then placed over it, located properly with pins and the two are clamped together, as shown in Fig. 1. Iron cope flasks are used, with iron cross bars that are shaped to leave about two inches of sand between the pattern and their edges. After the bars are braced with wooden strips, as shown, to prevent their springing, risers are placed on the two end flanges of the turbine pattern. Runners for the iron are provided for by placing sprues, consisting of square sticks, near the nozzle end of the pattern with their ends resting on the mold board. Gates are afterward cut from these to the mold. Certain cores have to be firmly fastened to the mold after it is completed, so small rods are put in proper position to make holes through which wires may later be passed. A stick is placed on the core print of the nozzle to leave a hole through which to vent the core.

After these preliminary operations, the placing of the sand is begun. First, all those parts that will cast into thick sections are covered with a special mixture of sand. By the use of this mixture the parts are cooled in about one-third the time required when placed in contact with ordinary sand. This makes the cooling of the thick and thin parts of the casting take about the same length of time and prevents any uneven casting strains.

After this special sand is placed, the entire pattern is covered to a depth of about one-half inch with very fine molding sand to give a smooth surface to the metal. On top of this layer are placed gaggers, that have been dipped in a clay mulch, to assist in holding the sand from falling out when handling the cope. After the gaggers are in place the cope is completely filled and heaped up with heavy molding sand. This is used because it is very porous and allows the rapid escape of gases when the mold is poured.

Jar Ramming

The next process is that of packing or ramming the sand around the pattern. The cope and mold board, clamped together, are placed on a Herman molding machine, commonly called a bumping or jarring machine, as shown in Fig. 2. This consists of a heavy iron table, 60x70 inches, which is raised slowly by compressed air and dropped with a sudden jar. It has a stroke of 4 inches. This packs the sand compactly and much more evenly than can be accomplished by any method of hand ramming. The number of bumps given any mold depends on its character and size. For turbine work it varies from 175 to 200. Usually once during the bumping process it is necessary to add more sand.

After being removed from the jarring machine, the sand on the surface of the cope is rammed with an air rammer and then struck off. The surface then is gone over with a hand rammer to give the finishing touches, after which the various runner, riser and sprue sticks are removed as well as the sticks for core wire and vent holes. The cope is then turned over so the mold board can be removed and the mold finished. In some cases soft spots in the sand appear in the surface next to the board. These are packed down and additional sand put on wherever necessary. Next, wire nails are driven into the sand immediately along the edge of the pattern to assist in holding the sand in position when the pattern is removed.

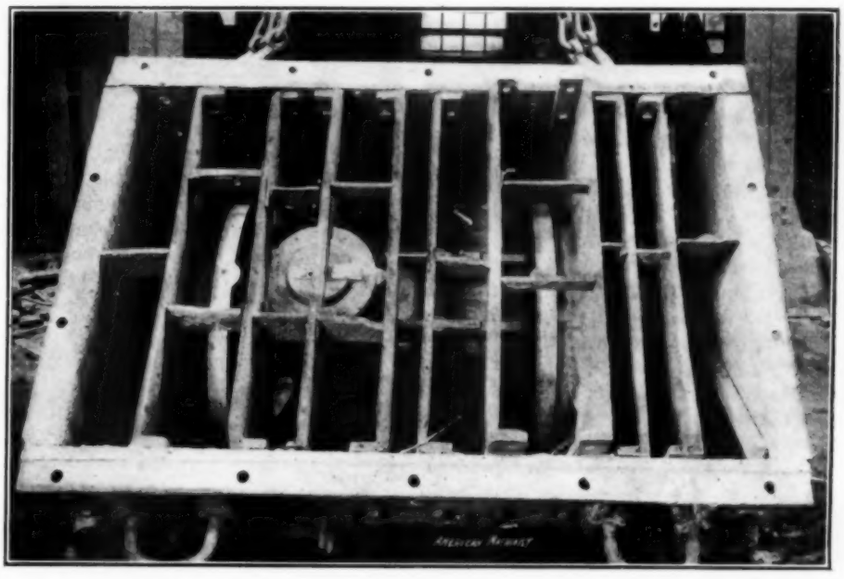


Fig. 1. Pattern Placed in Cope Ready for Ramming

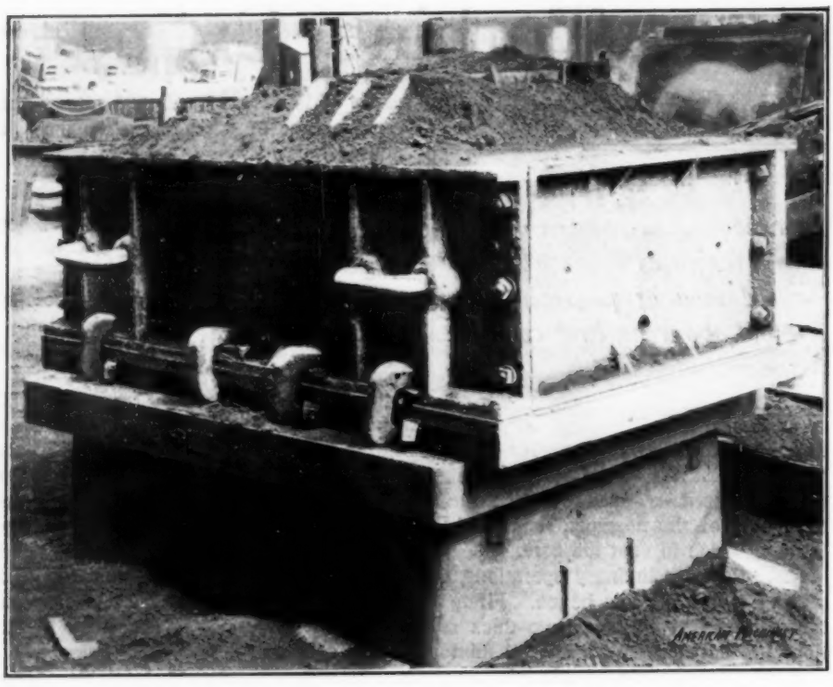


FIG. 2. COPE ON A 60x72-INCH JARRING MOLDING MACHINE

FINISHING THE COPE

The pattern is removed by using screw hooks and adjustable screw chains fastened to plates on the bottom of the pattern. Crane chains are hitched to these and the pattern is jarred, while drawing, so it will come out without trouble. No matter how careful a molder may be there are always some parts of a mold that are not perfect and these must be patched up. This is done with a trowel and slick.

Loose parts of the pattern, purposely so fastened that they will be left in the sand when the main pattern is withdrawn, are taken out and the whole mold carefully finished up, vent holes and gate holes are cleaned out, gates are cut from the runners to the edge of the mold and carefully rounded off. All loose sand is removed with an air blast and the final finish given to the mold, as shown in Fig. 3. This consists in blacking the entire surface with a solution of molasses water and graphite. Such a coating gives a firm even, smooth surface to the iron that not only improves its looks but also its texture.

GREEN-SAND CORE

As the cylinder is cast in halves the main cylinder core is made of green sand in the drag, in much the same way as the mold. This is shown in Fig. 4 with the core-sand nozzle core also in position. The core box, which is large and strongly framed, is placed with the iron drag section of a flask on it.

Sand of the special mixture mentioned is placed next the box and over this fine molding sand is shaken from a riddle. This is shaped to a circular section by the molder, who lightly compresses it with his hands. In the trough thus formed coke is placed to provide a vent for the core. Over the coke, strips of paper or hay are spread to prevent the sand working in. Coarse sand is then filled in and the drag heaped up. The drag and core box are clamped together and placed on the jarring machine and bumped. The drag receives only about one-half the number of bumps that the cope does, as it is only about one-third the hight of the cope.

After being bumped, the drag and core box are removed and the sand smoothed off. An iron plate is then clamped on the bottom of the drag to hold the sand in place and the whole thing is turned over onto this plate. The core box is then removed by the crane and the core finished up in the same manner as the mold.

The mold and core are placed on iron-framed cars and run into core ovens. They are kept in these usually about 12 hours while the temperature is maintained at about 700 degrees Fahrenheit. At this temperature the parts could be left for 24 hours without any ill effect. Baking the molds drives all moisture out of the sand, making the escape of gases much easier when pouring, and at the same time hardens it so that there is much less danger of crushing the mold than when the sand is left damp.

DRY-SAND CORES

Because of the somewhat complicated shape of the cores for the nozzles they are usually made in sections and pasted together. Ordinary core sand is used and rammed with small hand rammers, to the shape of the box. A frame is placed over the core box, the core covered by a thin layer of sharp sand, the frame filled with molding sand and the whole then dumped onto an iron plate. The intermediate layer of sharp sand allows the core to part from the supporting sand after it is baked. The molding sand, with the flat surface, supports the core while it is being baked. The vents in the core are made by inserting small strips of wax which melt when the core is baked.

Usually the cylinder is of such shape that it is possible to mold only part of it from the main pattern. For other parts core prints are made in the mold and cores used to give the proper shape to the casting. These are held in place by wires that are run through holes in the mold and twisted around pieces of iron on the outside. The joints are filled to the surface with ordinary molding sand and are

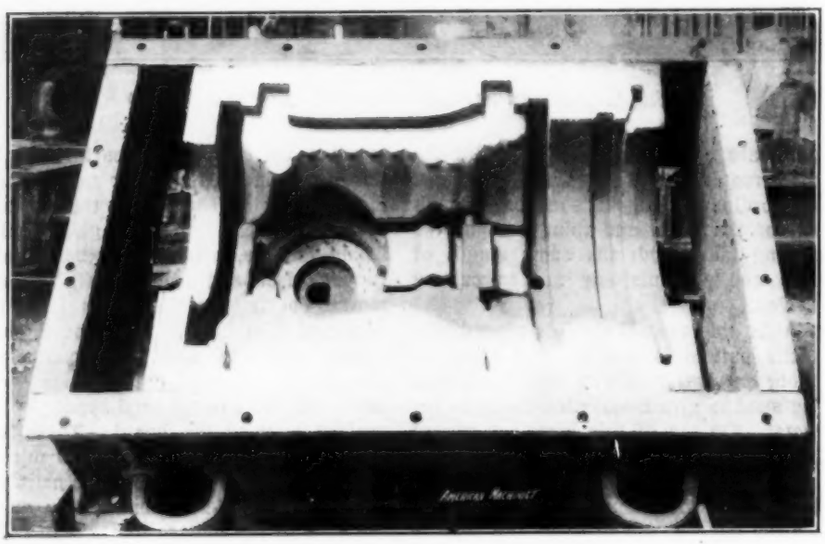


FIG. 3. COPE RAMMED UP AND ALL SMALL CORES SET

then covered with a graphite putty to give a smooth and even surface.

If any surfaces have been broken off so as to expose the bare sand, they are brushed over with oil, or if very large are patched with the graphite putty. The oil prevents the hot metal from cutting into the bare spot and thus causing a rough casting.

The main cylinder core is patched, if necessary, and then the smaller cores are placed in position on it, as shown in Fig. 4. The joints are closed with dough rolls and the edges are filled with fine sand and then plastered with graphite putty and given a smooth finish. The vent of the nozzle core is filled with finely powdered coke. Sometimes it is necessary to use a chaplet or stud to hold a core in position.

Finishing the Mold

After the mold and cores are completed and in position, flour is sprinkled around the edge of the drag containing the core. The cope is then placed in position temporarily and removed. The flour serves to "spot" the cope and show any inequalities of contact. After the cope is removed and any necessary changes made, a flange joint of dough is placed around the edge of the drag. The cope is then placed in position and the two are firmly clamped together.

The risers are built up about ten inches above the flask by placing a piece of pipe of large diameter around them and extending the holes, as shown in Fig. 5. This is to give a certain head to the metal. An iron pipe is also placed above the vent from the nozzle.

Surrounding the runners, or holes through which the metal enters the mold, there is built a runner dish or pouren, as shown to the extreme left of the mold. This receives the molten metal and distributes it to the two runners. It is made by placing a wooden frame around the gates and then filling it with sand which is rammed just hard enough to hold it in place. In the center there is a slight depression into which the metal runs before flowing to the runners, to prevent sand being carried into the mold with the iron. At each vent hole is placed a piece of oily waste

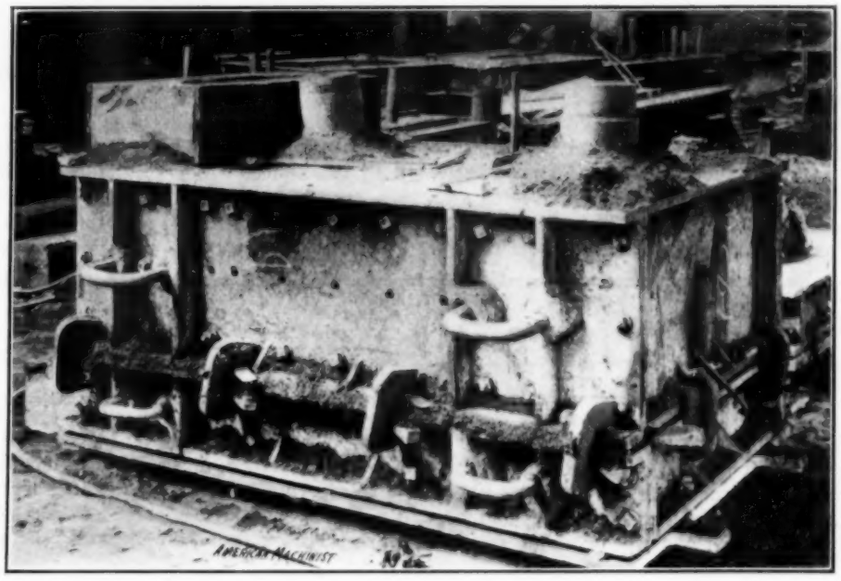


Fig. 5. Completed Mold of Steam-turbine Cylinder

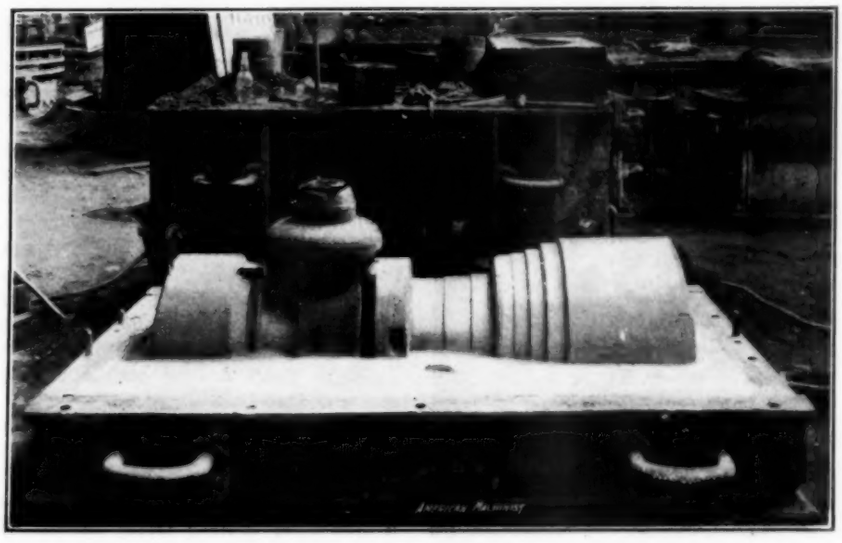


Fig. 4. Drag of Mold with Main Body Cores Set

Pouring the Mold

The molten metal is brought to the mold, in a ladle geared for tilting, by a crane. As the metal begins to run, the oily waste at the various vents is lighted and these ignite the gases escaping from the mold.

As soon as metal appears in the risers the flow of metal is stopped and that remaining in the pouren is quenched by throwing cold water upon it. At the same time feeding rods are worked up and

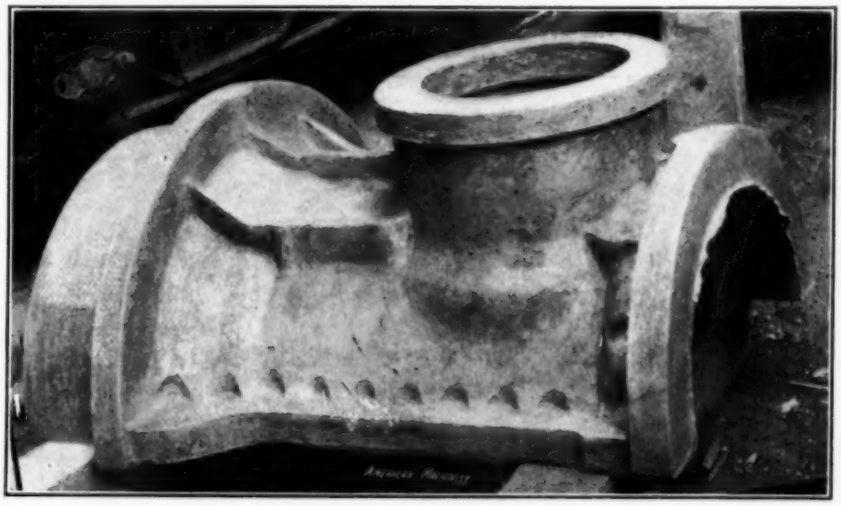


Fig. 6. Completed Turbine-cylinder Casting

down in the risers to churn the molten metal and keep it fluid so that the casting can take up the iron lost by shrinkage. As soon as this has been done sufficiently, as evidenced by the viscosity of the metal, cold water is poured in the risers to quench the iron there. The quenching of the metal in the pouren is to prevent a pumping or flowing of the molten mass which would otherwise occur during the churning. The quenching of the risers is to prevent the escape of metal due to the expansion of the cores and mold.

After the casting has become cold, usually during the night after pouring, the flask is removed from around it and it is cleaned up. The sand of the cores is broken out with bars, all risers, fins, etc., are chipped off with an air hammer and the casting is ready for the machine shop, as shown in Fig. 6.

This will serve to give a general idea of the methods employed and shows the care necessary to produce perfect castings. Under the conditions existing in the shops of Allis-Chalmers company ten complete turbine castings can be turned out each day with perfect assurance that the castings will be of the quality desired.

A Setting Device for Use on Planer

The halftone and line engraving illustrate a setting, or squaring, plate designed for use, not only on the planer and shaper but also on milling and boring machines and woodworking machinery. It is the invention of Joseph R. Willard, Chicopee, Mass. Its construction is so clearly illustrated as to require little description. The method of locating work square across the planer table or at any desired angle, will be obvious upon inspection of the engravings. The halftone shows the device in actual use for locating automobile cylinders which are strapped on the planer platen for the machining the bosses; the work in the case illustrated being set at an angle of 53 degrees.

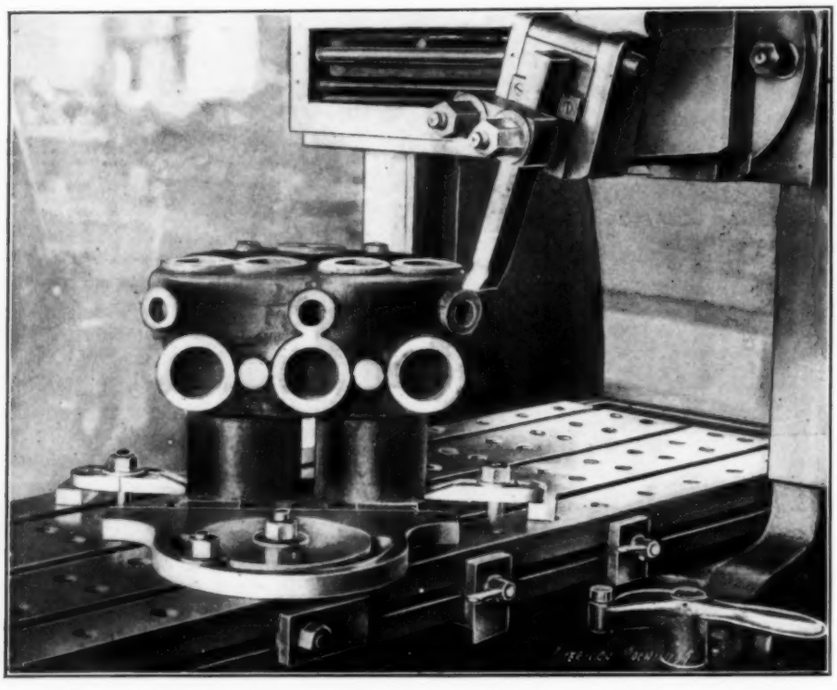


FIG. 1. SETTING DEVICE IN USE ON THE PLANER

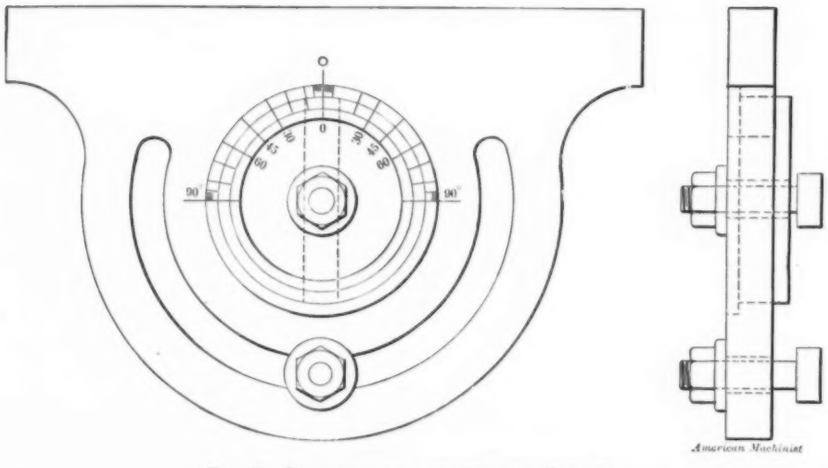


FIG. 2. CONSTRUCTION OF SETTING DEVICE

The New Customs Tariff of Japan

The new Japanese customs tariff, which will go into effect next year, on the expiration of the various treaties, agreements and conventions of Japan with foreign nations, contains a large number of changes and increases, and is of particular importance to the exporters of machinery in the United States and elsewhere. The present compilation represents the principal sections of the new Japanese tariff dealing with machinery and allied articles.

The new Japanese tariff does not contain as yet any conventional rates, for these are to be made on the basis of treaties which are to be concluded. As a free-trade country Great Britain will have no equivalent to offer for concessions and the tariff commission in London which is compiling data with regard to British trade relations as affected by foreign tariffs is of the opinion that about $5,000,000 worth of goods now exported to Japan from Great Britain will be excluded through the new tariff.

The increases in the new tariff refer principally to manufactures already established or about to be established in Japan. The decreases refer to planing machines, knitting machines and supplies for spinning mills—necessary items for the protection of the growing "infant industries."

The change from *ad valorem* duties to specific duties on the weight basis will be a set back to British imports into Japan, for the reason that their machines (as printing machines) weigh more than those manufactured by their competitors.

The tariff has been frankly dictated by a spirit of thorough protection to Japanese industries.

Balances, with weights or not:	
1. Platform balances:	
A. Each weighing not more than 40 kilograms	12.00 yen per 100 kin
B. Each weighing not more than 450 kilograms	7.50 yen per 100 kin
C. Other	5.15 yen per 100 kin
2. Other	20% *ad valorem*
Parts of balances and weights	20% *ad valorem*
Pressure gages, including vacuum gages	46.40 yen per 100 kin
Tachometers, ship's logs, steam-engine indicators, anemometers, dynamometers, cyclometers, pedometers and the like	20% *ad valorem*
Automobiles	50% *ad valorem*
Parts of automobiles, excluding motive machinery	30% *ad valorem*
Cycles:	
1. With motive machinery	93.60 yen each
2. Other	16.00 yen each
Steam boilers	3.70 yen per 100 kin
Parts and accessories of steam boilers, not otherwise provided for:	
1. Mechanical stokers	4.25 yen per 100 kin
2. Flanged boiler plates and corrugated boiler-furnace tubes	2.45 yen per 100 kin
3. Other	25% *ad valorem*
Fuel economizers	1.60 yen per 100 kin
Feed-water heaters	7.10 yen per 100 kin
Locomotives and tenders running on rails:	
1. Locomotives:	
A. Propelled by steam power	7.60 yen per 100 kin
B. Other	9.20 yen per 100 kin
2. Tenders	20% *ad valorem*
Steam locomotives not running on rails, portable steam engines and steam road-rollers	5.20 yen per 100 kin
Steam turbines	20% *ad valorem*
Steam engines, not otherwise provided for:	
1. Each weighing not more than 250 kilograms	16.00 yen per 100 kin
2. Each weighing not more than 1000 kilograms	9.00 yen per 100 kin
3. Each weighing not more than 5,000 kilograms	8.00 yen per 100 kin
4. Each weighing not more than 50,000 kilograms	6.00 yen per 100 kin
5. Each weighing not more than 100,000 kilograms	4.40 yen per 100 kin
6. Other	4.00 yen per 100 kin
Gas engines, petroleum engines and hot-air engines:	
1. Each weighing not more than 100 kilograms	30.00 yen per 100 kin
2. Each weighing not more than 250 kilograms	20.00 yen per 100 kin
3. Each weighing not more than 1,000 kilograms	9.00 yen per 100 kin
4. Each weighing not more than 2,500 kilograms	7.00 yen per 100 kin
Other	5.00 yen per 100 kin
Water turbines and Pelton wheels:	
1. Each weighing not more than 500 kilograms	26.00 yen per 100 kin
2. Each weighing not more than 1,000 kilograms	9.00 yen per 100 kin
3. Each weighing not more than 5,000 kilograms	8.00 yen per 100 kin
4. Each weighing not more than 10,000 kilograms	7.00 yen per 100 kin
5. Other	5.40 yen per 100 kin
Dynamos, electric motors, transformers, converters and armatures:	
1. Each weighing not more than 25 kilograms	26.00 yen per 100 kin
2. Each weighing not more than 50 kilograms	16.00 yen per 100 kin
3. Each weighing not more than 100 kilograms	14.00 yen per 100 kin
4. Each weighing not more than 250 kilograms	13.00 yen per 100 kin
5. Each weighing not more than 500 kilograms	12.00 yen per 100 kin
6. Each weighing not more than 1,000 kilograms	10.00 yen per 100 kin
7. Each weighing not more than 5,000 kilograms	9.00 yen per 100 kin
8. Other	7.00 yen per 100 kin
Dynamos combined with motive machinery:	
1. Combined with steam turbines	20% *ad valorem*
2. Combined with steam engines:	
A. Each weighing not more than 250 kilograms	15.20 yen per 100 kin
B. Each weighing not more than 500 kilograms	10.60 yen per 100 kin
C. Each weighing not more than 1,000 kilograms	10.20 yen per 100 kin
D. Each weighing not more than 2,500 kilograms	8.80 yen per 100 kin
E. Each weighing not more than 5,000 kilograms	8.40 yen per 100 kin
F. Each weighing not more than 10,000 kilograms	7.20 yen per 100 kin
G. Each weighing not more than 50,000 kilograms	6.40 yen per 100 kin
H. Each weighing not more than 100,000 kilograms	5.40 yen per 100 kin
I. Other	5.20 yen per 100 kin
3. Combined with gas engines, petroleum engines or hot-air engines:	
A. Each weighing not more than 250 kilograms	17.60 yen per 100 kin
B. Each weighing not more than 500 kilograms	10.60 yen per 100 kin
C. Each weighing not more than 1,000 kilograms	10.20 yen per 100 kin
D. Each weighing not more than 2,500 kilograms	8.20 yen per 100 kin
E. Each weighing not more than 5,000 kilograms	6.60 yen per 100 kin
F. Other	5.80 yen per 100 kin
4. Other	20% *ad valorem*
Blocks and chain blocks:	
1. Of wood	30% *ad valorem*
2. Other:	
A. Each weighing not more than 5 kilograms	30% *ad valorem*
B. Other	5.50 yen per 100 kin
Cranes:	
1. Combined with motive machinery	4.20 yen per 100 kin
2. Other	3.90 yen per 100 kin
Capstans, winches, windlasses and other winding machines not otherwise provided for:	
1. Combined with motive machinery:	
A. Each weighing not more than 1,000 kilograms	8.00 yen per 100 kin
B. Each weighing not more than 5,000 kilograms	6.00 yen per 100 kin
C. Other	5.00 yen per 100 kin
2. Other	3.85 yen per 100 kin
Dredging machines:	
1. Not framed	5.00 yen per 100 kin
2. Other	20% *ad valorem*
Power hammers:	
1. Steam-operated:	
A. Each weighing not more than 10,000 kilograms	3.65 yen per 100 kin
B. Other	2.40 yen per 100 kin
2. Other	20% *ad valorem*
Air compressors, ammonia compressors and other gas compressors	7.10 yen per 100 kin
Pumps not otherwise provided for:	
1. Of iron:	
A. Each weighing not more than 100 kilograms	12.00 yen per 100 kin
B. Each weighing not more than 500 kilograms	9.00 yen per 100 kin
C. Each weighing not more than 5,000 kilograms	8.00 yen per 100 kin
D. Each weighing not more than 10,000 kilograms	7.00 yen per 100 kin
E. Each weighing not more than 50,000 kilograms	6.00 yen per 100 kin
F. Other	4.60 yen per 100 kin
2. Other	20% *ad valorem*
Injectors and ejectors:	
1. Of iron	9.00 yen per 100 kin
2. Other	58.00 yen per 100 kin
Blowing machines	20% *ad valorem*
Hydraulic presses:	
1. Each weighing not more than 500 kilograms	9.00 yen per 100 kin
2. Each weighing not more than 1,000 kilograms	8.00 yen per 100 kin
3. Each weighing not more than 5,000 kilograms	7.00 yen per 100 kin
4. Each weighing not more than 50,000 kilograms	5.00 yen per 100 kin
5. Other	4.00 yen per 100 kin
Pneumatic tools	52.30 yen per 100 kin
Metal or woodworking machinery not otherwise provided for, including rolling machines, drawing machines, nail-making machines, molding machines, flanging machines, bending machines, riveting machines, etc.:	
1. Each weighing not more than 25 kilograms	37.50 yen per 100 kin
2. Each weighing not more than 50 kilograms	22.50 yen per 100 kin
3. Each weighing not more than 100 kilograms	14.30 yen per 100 kin
4. Each weighing not more than 250 kilograms	12.80 yen per 100 kin
5. Each weighing not more than 500 kilograms	11.30 yen per 100 kin
6. Each weighing not more than 1,000 kilograms	9.80 yen per 100 kin
7. Each weighing not more than 2,500 kilograms	6.80 yen per 100 kin
8. Each weighing not more than 5,000 kilograms	6.00 yen per 100 kin
9 Each weighing not more than 50,000 kilograms	3.80 yen per 100 kin
10. Other	3.50 yen per 100 kin
Machinery not otherwise provided for	20% *ad valorem*
Parts of machinery not otherwise provided for:	
1. Iron wheels:	
A. Toothed wheels	6.40 yen per 100 kin
B. Other	5.40 yen per 100 kin
3. Milling cutters and gear cutters	130.00 yen per 100 kin
4. Saws for machinery	11.10 yen per 100 kin

NEW RATES OF DUTIES ON MACHINERY AND ALLIED IMPORTS INTO JAPAN.

In effect, 1911, the exact date not yet announced.

(1 yen equals 50 cents. 1 kin equals about 1.32 pounds.)

Card System for Shop and Store Room

By C. T. Schaefer

A system of record cards used by a prominent automobile manufactory in keeping track and costs of parts passing from the store rooms, through the shops and inspection department, from the engineering department to the finished product.

The card system used in the manufacture of a very prominent automobile, and also used by quite a number of smaller concerns, is worthy of description.

This system seems somewhat expensive, but when taking into consideration its rapidity and the consequent time saved in locating any part or the amount of work done upon it, cost of material wasted, etc., it can be readily understood that an expensive system is better than a patched-up system, by which considerable time is wasted in looking up and comparing the different cards to ascertain their correctness.

As an example, we will take the automobile from engineering department to selling department, and show how parts are followed up in the shop. On page 726 of the AMERICAN MACHINIST was given a description of the system used in the engineering department and the method of caring for and issuing of blueprints into the shop. This article took care of everything until the manufacture of parts has begun in the shop, and this article will continue from that point.

FORM NO. 7

ORDER NO. 3911 PART NO. 8011

NAME Cylinders

ORDER ISSUED Feby 11-1910 NO. PIECES 50

MATERIAL Cast Iron AM'T REQUIRED 50

NO. PER CAR 6 FOR 8 CARS

REMARKS 2 Cylinders for 4 Cylinders Car in Experimental Room SIGNED C. T. Schaefer

ORDER CLOSED March 10-1910 PIECES REC'D 50

PIECES SCRAPPED ——— TOTAL 50

REMARKS 2 sent to Experimental Room

SIGNED J. E. Ellison Mgr

FIG. 1. ENGINEERING-DEPARTMENT CARD SENT TO WORKS MANAGER

FORM 8

ORDER NO. 3911 PART NO. 8011

NAME Cylinders NO. PIECES 50

														Total
1st OPERATION facing Ends	REC'D.	Date												
		Amt.												
	DEL'D.	Date												
		Amt.												
2nd OPERATION Drilling & Tube and Flue	REC'D.	Date												
		Amt.												
	DEL'D.	Date												
		Amt.												
3rd OPERATION Boring	REC'D.	Date												
		Amt.												
	DEL'D.	Date												
		Amt.												

American Machinist

FIG. 2. WORKS MANAGER'S CARD SENT TO GENERAL FOREMAN

Form 5.

SHOP REQUISITION

Machine Dept. Date Feby 12 1911

Deliver to Milling Dept. Charge to Card No. 3911

No. Ordered	No. Delivered	Name of Article	Unit Price	Amount
50	25	Castings 8011		
		2050 lbs.	10	2.05

Foreman

American Machinist

FIG. 3. SHOP REQUISITION ON STORE ROOM

THE SHOP SYSTEM

When the prints are issued to the tool room, the engineering department sends the card shown in Fig. 1 to the works manager, this card notifying him that prints have been issued and that work is to be started on these parts.

The works manager, upon the receipt of these cards, plans the operations in the order in which they are to be performed and writes out the card shown in Fig. 2, sending it to his general foreman, or assistant manager, who makes out the shop requisition on the storeroom for material. Fig. 3 shows the form of requisition used. The foreman then passes the operation card to his assistant in that department, which is to perform the first operation. The first operation being finished, the pieces are sent to the inspection room (with the operation card) to be inspected, the inspector making a copy of the operations upon his record card shown in Fig. 4. He then notes on his card in the column of first operation the number good and bad, returning the good pieces to the shop for the next operation.

These methods are continued until the job is finished, after which cards Figs. 1 and 4 are returned to the engineering department, and should the scrapage be too great, it is immediately looked into and remedied, whether it be in design, material, or fixtures. This method is also

FORM NO. 9

NAME Cylinders PART NO. 8011

ORDER NO.	OPERATION			OPERATION			OPERATION			OPERATION			OPERATION			OPERATION	
DATE																	
	DATE	GOOD	BAD	DATE	GOOD	BAD	DATE	GOOD	BAD	DATE	GOOD	BAD	DATE	GOOD	BAD	DATE	GOOD

FIG. 4

FORM 6

STORE AND STOCK RECORD CARD

DRAWING NUMBER 8011

NAME OF PART Cylinders

TYPE R. S. QUANTITY PER CAR 6

MATERIAL Cast Iron See B Bin 16

RECEIVED IN STOCK			EXPENDED			BALANCE ON HAND		DEFECTIVE PARTS OR SCRAP RETURNED			DEFECTIVE PARTS OR SCRAP SENT OUT	
DATE	CARD NO.	QUANTITY	DATE	CARD NO.	QUANTITY	DATE	QUANTITY	DATE	CARD NO.	QUANTITY	DATE	QUANTITY
3/1/10	3911	25	3/2	3983	6	3/2	19					
3/9/10	3911	25	3/3	3983	6	3/3	13					
			3/10	3983	6	3/10	7					
			3/16	3983	6	3/16	32					
						3/16	26					

American Machinist

FIG. 5 STOREKEEPER'S CARD

NAME Cylinders UNIT Lbs. SIZE 6 Cyl. CARD NO. 3911

AVAILABLE :-MINIMUM

ORDERED			REQUIRED		BALANCE AVAILABLE	MEMORANDUM OF MATERIAL PRICED ON BILLS OF MATERIAL							
DATE	ORDER OR REQ. NO.	QUANTITY	PROD. ORDER NO.	QUANTITY	QUANTITY	DATE	ORDER NUMBER	QUANTITY	UNIT PRICE	DATE	ORDER NUMBER	QUANTITY	UNIT PRICE
1/28/10	369	50	3911	50	0	2/10/10	3911	25	.10				
						3/1/10	3911	25	.10				

FIG. 6

Form No. 5 8011 CARD NO.

NAME Cylinders UNIT Lb. SIZE RACK NO. BIN NO.

RECEIPTS					ISSUES					ISSUES					
DATE	INVOICE OR ORDER NO.	PATTERN OR DIE NO.	QUANTITY	UNIT PRICE	DATE	REQ. OR GEN. ORDER NO.	PATTERN OR DIE NO.	QUANTITY	UNIT PRICE	DATE	REQ. OR GEN. ORDER NO.	PATTERN OR DIE NO.	QUANTITY	UNIT PRICE	BALANCE ON HAND	DATE
2/10/10	36592	8011	25	.10	2/10/10	3911	8011	25	.10	2050 lbs.						
3/1/10	40683	8011	25	.10	3/1/10	3911	8011	25	.10	2053 lbs.						

American Machinist

FIG. 7

STORE-ROOM CARDS

followed in the assembling units and also the complete car, but there, instead of making requisitions on the rough storeroom, the same requisitions are made out for finished parts, on the finished storeroom, and charged to the job number of the assembled unit.

FINISHED STORE-ROOM RECORDS

The method of keeping track of parts in the finished storeroom is quite simple. When the parts are finished, they are sent to the storeroom and the storekeeper notes on the card shown in Fig. 5, the date and quantity finished, in the first card division. In the second division is noted the amount sent to the assembling departments, the third division showing the balance on hand, the fourth and fifth divisions caring for the defective parts. The order number distinguishes the different lots passing through the plant.

THE ROUGH STORE-ROOM AND PURCHASING-DEPARTMENT RECORDS

The rough storeroom and purchasing department were combined, to simplify the system and records. Fig. 6 shows the card which takes care of the amount ordered, on one side; Fig. 7 showing the reverse side of this card, caring for receipts, issues to shop and balance on hand. This enables the purchasing department to ascertain the quantity to be ordered. The purchasing agent also has a duplicate of card, Fig. 1, always at hand. Bar stock is cared for by the card shown in Fig. 8, which is simple and requires no further discussion.

METHOD OF OBTAINING COST

In Fig. 9 is shown the time card used, which takes care of the labor in the plant, and at the end of every second week, when the payroll is made up, the amounts are charged to the different job numbers on the cost cards shown in Fig. 12. This side of the card takes care of the labor, while the reverse side of the card, Fig. 11, takes care of the material, this latter being entered from the shop requisition, Fig. 3.

When a job is completed, the card shown in Fig. 12 is filled out as shown, and from time to time, as the different lots are finished, this card is carried on file until this particular piece is discontinued. This card will also show the advantage of the different manufacturing methods, or should different men do the work, as some men are faster than others. When piece work is resorted to, the number of pieces finished is entered on the time card, by the foreman in charge.

In conclusion, I might add that this entire system is the result of careful study and experimental work along these lines

TIME STARTED 7.10 a.m. | Order No. 3911 | Item No. 8011 | Check No. 46 | Hrs. | Rate | Amt. | TIME FINISHED 5.30

__DAY WORK. Hrs. Rate Amt. PROD. HRS. AMT.

Date 2/27/10 Check No. 46 AMT.

Workman's Name C. J. Galli

Foreman J. M. Whaley Entered 3/15/10

American Machinist

FIG. 9. TIME CARD

FORM 3 MANNHEIMER PRINT

KIND OF MATERIAL Rd. Screw Stock

SIZE OR NAME 3/8"

PER / CARS					ORDERED & RECEIVED				
DRAW NO.	TYPE R.S.	TYPE	TYPE	TYPE	AM'T	DATE WANTED	FROM		REC'D
8014	3"								
8019	1¼"								
8112	2"								
8179	1¾"								
8201	4"								
						TOTAL		TOTAL	
					DRAW NO.	REPAIR	SPECIAL	SCRAP F.O.	AM'T
TOTAL					TOTAL			TOTAL	

American Machinist

FIG. 8. CARD FOR BAR STOCK

FORM NO. 11 PART NO. 8011

NAME Cylinders

ORDER NO.	FINISHED	AMT.	MAT.	LABOR	COST (ACT.)	BILLING COST	REMARKS
3911	4/1/10	50	8.206	2.868	11.074		25% shop expense added

American Machinist

FIG. 10. RECORD CARD FILED AWAY

FORM 10

CARD NO. 3911 50 pcs. 8011			CARD NO.			CARD NO.		
DATE	AMT. MATERIAL	COST	DATE	AMT. MATERIAL	COST	DATE	AMT. MATERIAL	COST
3/11/10	25 pcs Gray Iron Castings. 2050 Lbs	205.00						
3/1/10	25 pcs. Gray Iron Castings. 2053	205.30						
TOTAL		410.30						
SCRAP OR RETURN TO STOCK		{No pieces made 50}						
TOTAL MATERIAL		410.30						
LABOR		114.75						
SHOP EXP. 25%		28.69						
COST OF JOB		553.74						

American Machinist

FIG. 11. COST CARD SHOWING MATERIAL

CARD NO. 3911 50 Pcs.				CARD NO. Cylinders. #8011				CARD NO.			
DATE	PC. WORK	DAY WORK		DATE	PC. WORK	DAY WORK		DATE	PC. WORK	DAY WORK	
3/15/10		10	75								
3/15	10	60	20 90								
3/30	15	70	18 20								
4/1/10	16	-	22 60								
	42	30	72 45								
				Pc. Work		42	30				
				Day "		72	45				
				Total.		114	75				
				Job finished 4/1/10							
TOTAL				TOTAL				TOTAL			

American Machinist

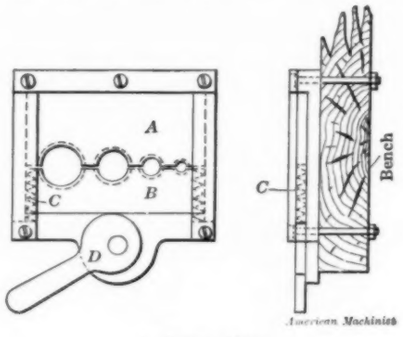
FIG. 12. COST CARD SHOWING LABOR

and has now been in use for several years. There is, as said, considerable expense attached to it, but when the functions taken care of are considered, it will be appreciated that it is a very conservative expenditure and a necessity in a large plant.

A Stud Vise

BY F. E. SPERRY

The device shown in the cut is very convenient where studs are to be held. The plates *A* and *B* are the jaws of the vise, the threaded stud grips being cut a little less than half in each jaw to allow them to grip tight upon the studs. The



A STUD VISE

jaws *A* and *B* are made to separate by the springs *C*, and are brought together by means of the eccentric lever *D*. The whole arrangement is bolted to the bench and is low lying, so that all operations upon the stud may be made without interference.

A very easy and cheap method of etching names on steel products, such as knife blades, is to coat the surface of the steel with gum—guaacum—varnish, and thinly coat a regular rubber stamp with a potash solution. Impression on the varnished surface with the rubber stamp removes the varnish, leaving the steel free to be etched by dilute nitric acid.

Preserving Rubber Tubing, Etc.

The following will, no doubt, be of use to many shop managers:

A mixture of ammonia, 1, and water, 2, has been recommended for this purpose. The articles are immersed in the liquid for a length of time varying from a few minutes to half an hour or an hour until they resume their former elasticity, smoothness and softness. Another method, based on the destruction of the substance by the slow formation of sulphuric acid by the action of moist air on the contained sulphur, consists in frequently washing the articles with slightly alkaline water, which prevents the action of the acid. Tubing washed five or six times a year in this way remains elastic for a long time. It has also been advised that the articles should be immersed in a bath of melted paraffin for a few seconds or several minutes, according to the size of the articles, and then dried in a room heated to about 212 degrees Fahrenheit. A writer in *Berichte* says that the hardening is caused by gradual evaporation of the solvent liquids contained in the rubber, and he finds that keeping in an atmosphere saturated with the vapors of the solvents answers the purpose well. Keeping the goods in air-tight vessels simply is sufficient to preserve them for a long time. Exposure to light and air should be avoided as far as possible. In our own experience we have had very good results by storing the rubber in well closed tin boxes containing some quicklime and ammonium carbonate, a method which insures a dry and alkaline atmosphere.—*Pharmaceutical Journal.*

Letters from Practical Men

A Tape Wrapping Machine

Concerning the details of making things in machine shops, from the first sketch to the shipping room.

A letter good enough to print is good enough to pay for. The value is in the idea—not the length of the letter.

Having occasion to make several hundred wiring forms a day, similar to the one shown in Fig. 2, and on account of the necessity of wrapping these wiring forms with linen tape ½ inch wide to bind them closely together, the efficient little machine herewith illustrated and described was devised by the writer to wrap them with tape.

This machine is shown in detail in Fig. 1, wherein *A* represents a cast-iron base, machined on the bottom at the two supporting pads, and also on the top surface, to which is attached by means of four fillister-head screws, the frame of the machine which carries the tape bobbin. This frame is composed of two bronze castings *B* and *C*, which are fastened to each other by the five fillister-head screws arranged around the circumference, as shown in the drawing.

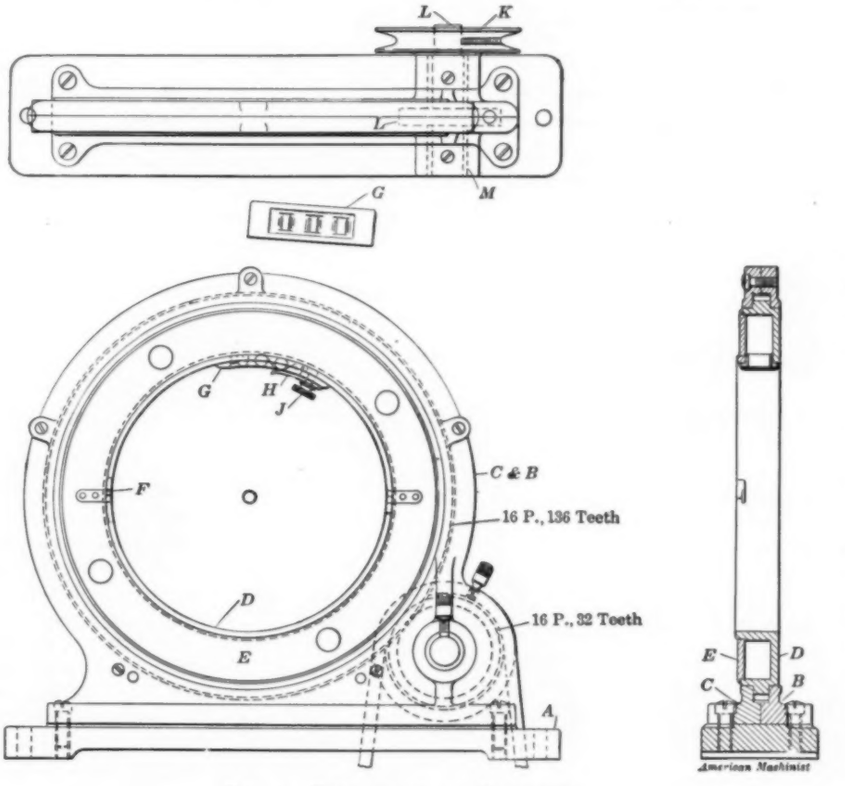


FIG. 1. TAPE-WRAPPING MACHINE

The frame is machined on the inside to accommodate the tape bobbin *D*, which is made of steel and machined all over. A flange projecting around the outer circumference of this bobbin is provided with 136 teeth of 16-pitch, into which mesh the teeth of the driving pinion *L*, which is of steel turned integral with the shaft and containing 32 teeth, 16-pitch, and which runs in bronze bearing bushings driven into the projecting bosses on the two frame castings *B* and *C*. A V-pulley *K* is attached to the pinion shaft *L* by means of a heavy set screw and a Woodruff key and serves as the means of driving the machine.

A brass disk, or ring *E*, provided with four round finger holes by which it may be removed, and equipped with two projecting ears *F*, which interlock with the tape bobbin *D*, as shown in sketch serves to retain the tape in the bobbin. Attached to the inner circumference of the bobbin is a hardened-steel friction block *G*, containing three openings through which the tape is zigzagged, in order to put a tension on it. A small nurled screw *J* is used to compress a friction spring shoe *H*, which regulates the tape tension.

The machine is mounted on the edge of the bench and driven with a small electric motor, the speed of which is regulated by a foot-pedal controlled rheostat.

To use the machine it is necessary only to start the end of the tape on the wiring form and hold it with the thumb until a couple of turns are wrapped of the form, after which the form is simply passed through the machine at the proper speed and held by the operator's hands on each side, allowing it to "float" within the opening so as to keep uniform tension on the tape. The projecting wires on the form are passed, when reached, merely by tilting the form from right to left, in order to dodge the revolving tape.

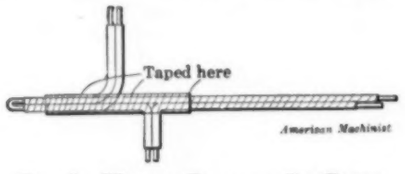


FIG. 2. WIRING FORM TO BE TAPED

Rolls of tape are carried on a thin steel band of the proper size to slip easily into the bobbin and after being pushed into position, the band is then withdrawn and the inner end of the tape threaded through the tension block *G*.

As the tape is consumed from the inside of the roll, it always remains loose in the bobbin and the roll slips around within the bobbin in the direction opposite to the bobbin rotation.

This machine has been in successful operation for nearly a year and will tape nearly three forms in the same time formerly consumed in taping one by hand, besides doing a very much neater job and being more economical with tape.

The bobbin holds sufficient tape to wrap 50 forms, and is easily reloaded in two or three minutes.

Peoria, Ill. C. C. CASEY.

Removing Stubborn Wood Screws

To remove a stubborn wood screw from a piece of wood, heat any sound piece of iron red-hot, and hold it against the screwhead for a little while. Wait for the screw to cool down, when it will be found that the screw can be removed quite easily with the same screw driver that just previously would not budge it.

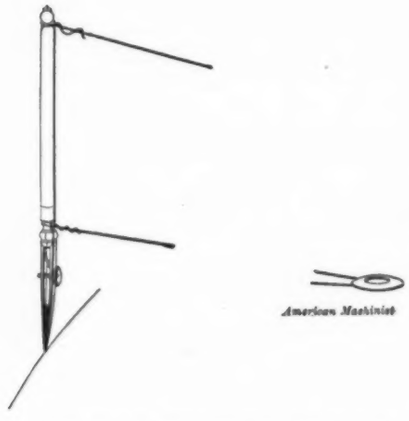
The explanation is simple: The red-hot poker heats the screw, which expands and makes the hole it is in a little bigger. The screw then cools off and resumes its original size, leaving the hole in the wood large.

H. D. CHAPMAN.

Washington, D. C.

Drawing Large Radii without Trammels

The illustration shows a method of drawing large curves when no trammels are available. Stick a thumb tack in the board at the correct center and slip the loop of a piece of fine binding wire underneath, around the pin body, which forms a pivot. Carry the ends of the wire to the drawing pen and attach them as shown by twisting round the body at two locations. Then by a little manipulation of one end of the wire the pen is brought to the exact radius and the curve struck. At first sight it might appear that a single strand of wire from the pin to the pen would suffice, but this, of course, would exercise no control over the tilting tendency of the pen and it would be impossible to produce a neat and accurate curve.



DRAWING LARGE RADII WITHOUT TRAMMELS

London, Eng. FRED HORNER.

Objects to Catalog in Books

I should like to enter a protest against the practice of incorporating a book catalog in the back part of various works. A few pages are not objectionable, but when 50 to 60 pages are included, the size is increased unnecessarily and one's library contains too much useless matter, especially as this is repeated in volume after volume.

This practice occurs mostly in small works of 100 pages or less, and is followed mostly by English firms.

Syracuse, N. Y. S. T. FAGO.

Table of Wire Areas

Some time ago I was designing a machine for handling small wire pins, and in one of my calculations I had to use the area of the wire. I had no data on areas of wire gage sizes, so I calculated the table for my own convenience. While this table may not have a very wide application, the information was useful to me, and I believe it may be of service to others.

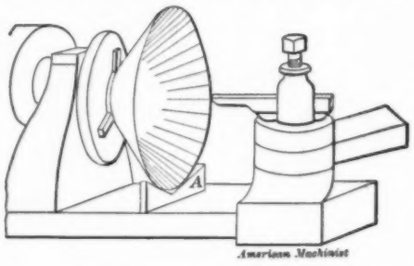
No. of Gage.	Birmingham or Stubb's Iron Wire.	Brown & Sharpe.	British Imperial or New British.	United States.	Stubb's Steel Wire.	American Steel & Wire Co
0000	0.162	0.167	0.126	0.130		0.122
000	0.142	0.132	0.108	0.111		0.104
00	0.113	0.104	0.095	0.093		0.086
0	0.091	0.083	0.082	0.077		0.074
1	0.071	0.066	0.071	0.062	0.041	0.063
2	0.064	0.053	0.060	0.056	0.038	0.054
3	0.053	0.041	0.050	0.049	0.035	0.047
4	0.045	0.033	0.042	0.043	0.034	0.040
5	0.038	0.026	0.035	0.038	0.033	0.034
6	0.032	0.020	0.029	0.032	0.031	0.029
7	0.025	0.016	0.024	0.027	0.031	0.024
8	0.021	0.013	0.020	0.024	0.031	0.020
9	0.017	0.010	0.016	0.019	0.030	0.017
10	0.014	0.008	0.013	0.016	0.028	0.014
11	0.011	0.0063	0.010	0.013	0.027	0.012
12	0.009	0.0055	0.009	0.009	0.027	0.009
13	0.0071	0.0039	0.0063	0.0071	0.026	0.0063
14	0.0055	0.0031	0.0047	0.0047	0.025	0.0047
15	0.0039	0.0024	0.0039	0.0039	0.025	0.0039
16	0.0031	0.0024	0.0031	0.0031	0.024	0.0031
17	0.0024	0.0016	0.0024	0.0024	0.024	0.0024
18	0.0016	0.0016	0.0016	0.0024	0.022	0.0016
19	0.0016	0.0008	0.0016	0.0016	0.021	0.0016
20	0.0008	0.0008	0.0008	0.0008	0.020	0.0008
21	0.0008	0.0006	0.0008	0.0008	0.020	0.0008
22	0.0006	0.0005	0.0006	0.0008	0.019	0.0006
23	0.0005	0.0004	0.0005	0.0006	0.018	0.0005
24	0.0004	0.0003	0.0004	0.0005	0.018	0.0004
25	0.0003	0.0002	0.0003	0.0004	0.017	0.0003
26	0.0002	0.0002	0.0002	0.0003	0.016	0.0002

AREA OF WIRE GAGE SIZES.

Plainville, Conn. SIDNEY C. CARPENTER.

Boring a Large Cone

One of the great difficulties in machining many pieces is the impossibility of properly supporting the metal against vibration under the action of the cutting tools. A case of this kind is shown in the accompanying illustration in which a large cast-iron funnel, possibly 48 inches across was being turned out in a lathe which would barely swing it properly.



TURNING A LARGE CONE

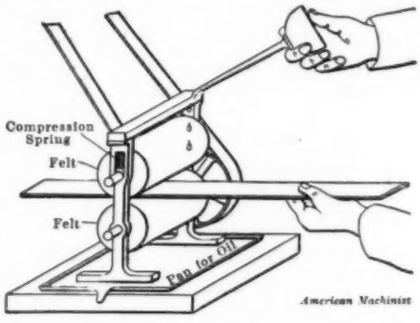
The only way of holding and driving this was by a flange on the small end as shown and it was one of the most uncomfortable jobs to handle that we have had recently. The only support we could give this was in the shape of a large wooden bearing at *A*, made from a piece of heavy planking which was cut out into a sort of V of the proper size to help support the work. This not only helped to prevent the overhang working the funnel out of the chuck but it also assisted greatly in reducing the vibration which interfered seriously with the work.

It is not claimed that this simple device made it possible to do the best kind of a job, but it helped out when nothing else seemed to be available.

Chicago, Ill. FRANK C. HUDSON.

Oiling Sheet Metal for the Punch Press

No, the sketch does not depict a roller-mill, neither a multigraph nor a clothes-ringer. It is simply a device for distributing oil on strips of sheet metal before they go to the punch-press. Ordinarily this oiling is done in a desultory way, the operator squirting oil indiscriminately and impartially on the stock and himself as the former progresses through the machine, results being as unsatisfactory as they are uncertain and ununiform.



OILING SHEET METAL FOR THE PUNCH PRESS

The illustration shows how the work is run through between the rolls. These are covered with felt to absorb and distribute the oil which is applied at intervals and not continuously as might be inferred from the sketch. Nor is the oil dropped on the work, as might also appear, but on to the rolls to be absorbed thereby as described. The strips are run through at something like sixty feet a minute and it is surprising how uniformly they are oiled on both sides. I would, however, add an oil pump and a comb-like distributer similar to those seen on automatic screw machines, the former to pump up the oil from the pan below and the latter to insure a more even and uniform distribution of the oil to the rolls.

However, the machine is splendid just as it is and has paid for itself over and over again. I know of no law yet to keep me from saying that it is eminently "oil-right."

Sumter, S. C. S. C. MCKEOWN.

Double Screw Machine Jobs

Does it pay to make two pieces at one time on the automatic screw machine? This question is receiving a great deal of attention lately, and I wish to show that, in general, double jobs do not allow as large production as the single layout, and also that the work cannot be held so close as in a single job.

In Fig. 1 is shown a double job, made on the No. 2 Brown & Sharpe automatic screw machine, which was pointed out to me in a small shop which I visited. The operator explained that he had doubled the output by making two pieces at one time. Becoming interested, I took the measurements of the piece and later figured out what the production would be with a single layout of cams.

Let us consider the disadvantages shown in Fig. 1. The tool *A* is expensive to make, as the thickness of the cutoff part must be exact, and is expensive to keep up, because the work often sticks in between the tool projection and breaks off large pieces. With the single layout, I use a standard tool to cut off. Next we consider the variations in the work. Unless the tools are held in almost exact relation to each other, we have one piece with a short stem, and the other piece with a long stem.

The argument usually put forth for the double job is that a great deal of time is saved by forming two pieces with one travel of the tool, but even more time can be saved on the single job, because we can cut off and form at the same time. This cannot be done when making two pieces at once, and besides this, the form tool for the double job is twice as wide as for one piece, plus the width of the cutoff tool. This wide form tool is shown by *B*, Fig. 1. It will be found by test that this form tool will stand up with a maximum feed of 0.0005 inch per revolution of the spindle, while the form tool in Fig. 2, being narrow, can be fed at 0.0012-inch chip per revolution of the spindle.

The following comparisons of cam layouts show the advantage and gain in production of the single job, over the double one:

SINGLE JOB.

ORDER OF OPERATIONS.

	421 revolutions per minute.	Hundredths of cam.
Feed stock to stop	9	4
Cutoff, 0.395-inch throw, at 0.002-inch chip	201	96
(Form, 0.255-inch throw, at 0.0012-inch chip)	(201)	(96)
Total number of revolutions for one piece	210	100

Thirty seconds to make one piece. Gross product in 10 hours, 1200 pieces.

DOUBLE JOB.

ORDER OF OPERATIONS.

	421 revolutions per minute.	Hundredths of cam.
Feed stock to stop	28 revolutions	3
Form, 0.255-inch throw at 0.0005-inch chip	510	54
Cutoff, 0.395-inch throw at 0.001-inch chip	409	43
Total number of revolutions for one piece	947	100

Maximum surface speed of stock, 83 feet per minute. Number of seconds to make two pieces, 135. Gross production in 10 hours, 532.

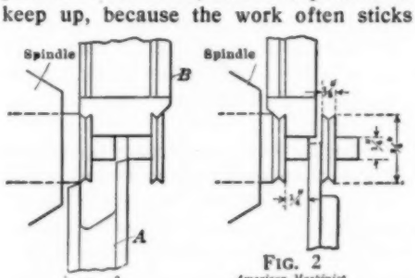


FIG. 1 FIG. 2 *American Machinist*

TWO METHODS OF MAKING A PIECE ON THE AUTOMATIC SCREW MACHINE

There are other ways, however, of making two pieces at one time, which are highly satisfactory, and which I hope to describe in a future article.

Cleveland, Ohio. S. H. BACON.

Stamping Cutting Tools

I wish to draw the attention of milling-cutter and cutting-tool manufacturers to the matter of stamping on the tool the make or temper of the steel used in its making.

As has frequently happened, I have had to anneal various sorts of cutters and tools. Then after the tool room was through, being called upon to retemper them, I was at a loss to know just what treatment to give them. Therefore does it not seem desirable to have some standard system of marking, so that the toolsmith could handle them more intelligently?

Lansing, Mich. H. M. BROOK.

Mechanical Word Pictures

The above title will bring to some reader's mind the vivid descriptions of things technical by some of our lay journalists in the daily press. It is not these pictures that require ventilating in the columns of our technical press, but the more important descriptions, by men in our own profession, of things mechanical.

How can we explain the fact that when a letter or order has been received from a business house engaged in similar engineering pursuits to ourselves, it is often unintelligible. Numbers of these documents are handed over to those who have become experts in guessing competitions, or are blessed with second sight.

Does it not seem ridiculous that we should require our own language interpreted for us?

It has been my lot to have a large amount of this correspondence to deal with, and the result is a number of needless gray hairs. These descriptions are of machine parts of one's own manufacture and have been dictated by mechanics who require the parts.

The real complaint is that though all engineers can draw an accurate *line picture* which would enable any mechanic to duplicate the part required, few can draw a *word picture* which is intelligible, even to the makers of the machine.

No doubt some of this is due to clerical staff "editing" the shop man's dictation in an attempt to improve it as a literary effort.

The chief reason is that most people seem unable to place themselves in an outsider's position when they read their own description.

Another confusion, well known in the repair department, is the inclosed part sent for guidance. The piece required probably is 200 pounds weight and ten years old, but the broken part inclosed is sent through the post and is about the size of a postal stamp.

Unfortunately, we find the departmental heads in our own factory asking for *those* shafts and thinking you thick headed if you require further particulars before you can supply from the hundreds of varieties being manufactured.

I have found that a plan which saves time and trouble is to forward with each machine despatched several sectional cuts of the mechanism. Under each illustration is printed this instruction: "When ordering replacements, please return this section with the part required clearly marked; also give the number stamped on machine." This simple plan has proved a great boon to a previously harassed staff, and can doubtless be followed to advantage by others, who, like myself, despair of educating the rest of the profession in the use of their own language.

London, Eng. T. ALEXANDER.

Discussion of Previous Question

Another Stubborn Repair Job

Letters from our readers showing how many men of many minds look upon various subjects opened up in previous numbers.

Your correspondent, H. B. M., Milwaukee, relates an experience on page 839, Volume 33, Part 1, which recalls a similar job, which I tackled as a lad, barely out of my time.

I was instructed to proceed to a laundry to fit some new solid clutches to some shafting, and set forth with the usual kit, files, hammer, chisels, hack saw, spanners, etc., not anticipating anything out of the ordinary.

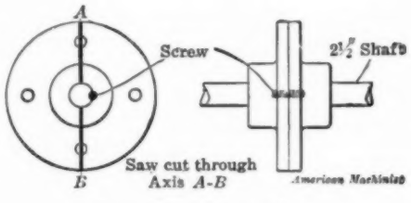
The job was situated quite 20 miles away from the works, and on arrival I proceeded to do a few little jobs, as several of the machines were required and the engine could not be shut down.

It was well into the afternoon before I commenced on the shafting job, and I unscrewed the bolts from the flanged coupling so that I could remove it and fit the clutches which I had brought. On looking for the keys, I was surprised to find that there did not appear to be one in either half of the coupling. I accordingly took off the top caps of the bearings, and hoisted the shafting a few inches from its position. Imagine my surprise when I found that the shafting had been drilled and endwise tapped, and a screw inserted, screwed home and the head knocked off.

Here was a poser for me, I had no "husky helpers," drilling tackle, or means of dismantling the shaft to use a drill, so that it was only waste of time to consider the drilling out of the old screws. The shafting was 2½ inches in diameter and I found that the firm had a Smith's coupling the same size. My mind was made up that if the new machines were to run the following Monday I must get the offending coupling off.

I decided to saw through the bolt holes of the flanges and as far through the bosses of the coupling as I could, then split the coupling in half with a hammer and chisel. It was Saturday afternoon, and only having about four saw blades, I realized that I must use my small stock as carefully as possible as I had no means of replacing them. I soon made an impression on the flanges, and the metal removed in drilling the bolt holes was of some assistance, but the difficult part of the job was in sawing the bosses. My position was anything but comfortable, sitting on a thin plank, high above the hot machinery, my knuckles were constantly getting knocks against the shafting, but I persevered and succeeded in cutting the first half close down to the shaft, without breaking a single blade. The strength of the saw blade was only sufficient to allow about 1½-inch stroke with the saw, when sawing the full length of the bosses.

After a few minutes' respite, I barred the flywheel around the engine and got the sawed half of the coupling looking downward, then commenced to saw the opposite half of the coupling. This time I was not quite so successful, as I was getting tired, and my stroke was not so steady as when I commenced, the result was that two or three of my blades were broken. However, I finished cutting down to the shaft, and a few sharp blows with a hand hammer completed the task.



STUBBORN REPAIR JOB

The whole job had not taken me two hours, and I cannot help thinking that H. B. M. and his "husky helpers" would have saved a large amount of the three days on their coupling, had this method been used. Though of larger dimensions, with all the assistance of clamps, blowpipe, work-shop appliances galore, not to speak of the sound work-shop advice, of which they had the advantage, I am sure that if their method had been resorted to, with a works standing for the job, the average "boss" would have called in other help, long before three days were up.

After all, difficulties show what we are made of, and such jobs as these would only have put a little relish into the day's work of the old-time fitter; the pity is, that under present methods of manufacture, the average boy gets little opportunity of proving his own skill, and getting confidence to fit him for any problem which may come his way in after life.

Concluding, I do not see any remark as to how true that shaft ran after three days' work by H. B. M., and his three or five helpers, and if it took them half as long to get the coupling off, they may well congratulate themselves that it was in the shop when all this happened.

Liverpool, Eng. LOCKWOOD.

Progress and Hustle

Referring to "Entropy's article on "Progress is Not Necessarily Connected with Hustle," on page 127, he tells us some facts, of which the title of the article is the most important. But it seems to me he does not quite place credit where credit is due. He gives all credit to the slow-working result producer of the country shop, and strips the city machinist of any credit by picturing him as a hasty, hustling, nervous man incapable of doing close work on account of his hustling, nervous ways, and Entropy half accuses him of trying to bluff someone into believing he is working.

Entropy is right when he says the best man is he who acts at ease with everything that turns up. The best man cannot do anything else. It's an impossibility to read 0.0001 inch at a hasty glance. It's an equally impossible feat to feel 0.0001 inches in a nervous, restless manner (I have not got the 0.0001 limit bug either). If you can't sit down on your stool, feeling confident of your own ability, pick up your micrometer or vernier, as the case may be, adjust yourself to the best light, see that your eye glass is nice and clean, then read your instrument, without haste and nervous hustle, then you have not got much chance of getting your dimension. The machinist who does close work cannot afford to bluff a hustle attitude for anyone's benefit.

Of course there are nervous hustlers in all the piece-work, automatic, multiple-spindle, four-machine "intensive manufacturing" departments of the city shops, while the country machine shop knows nothing of this "uptodateness."

All in all, the best work, the finest work, the work that calls for the greatest skill is done in the city, and the best mechanics must necessarily be where the best work is done. It is a hard task for anyone to try to browbeat him into the hustling, bustling, nervous worker Entropy pictures him, for he knows his capabilities and also his limitations.

JOHN MELVILLE.

Newark, N. J.

Training Apprentices in Trade Schools

Realizing that B. M. W. Hanson, the author of the address printed at page 72, is undoubtedly a reader of the AMERICAN MACHINIST, and also that the apprenticeship subject is one that is always a live one, I wish to ask a few questions. Mr. Hanson states as a fact that trade schools "will never teach him (the pupil) to make it quickly, neither will they be able to teach him the most uptodate methods. They will not be able to teach him the value of time, of jigs, gages and fixtures as there would not be enough pieces made in a trade school to make the boy fully realize the value of such tools. Neither could there be the diversity of machinery used in a trade school as in a machine shop."

Now these statements, being made as facts, not as individual opinions, and being made by a man in a prominent position, if passed by in silence will do much to harm such schools as ours in Worcester; therefore, I feel constrained to ask that Mr. Hanson explain why all these different things must be so if such is really the case. Why cannot a trade school teach a boy to make a thing quickly? Why cannot a trade school teach uptodate methods? Why cannot they take their work in large enough lots to teach a boy the value of jigs and fixtures? Why cannot a trade school have all the diversity of machinery used in a machine shop?

What the answer can be I cannot imagine, for here in Worcester we are certainly teaching boys to do work more quickly every day. We are making and using jigs and fixtures and we are taking our work in lots averaging 50 of a kind at least. Some pieces have run up into the hundreds, very few have run as low as a dozen. We have borrowed jigs for our work whenever we could and where. As has happened time and time again already, the uptodate shops from which we have taken our work have not had the jigs that we have thought would help us and we have made them ourselves, not for the benefit of those shops but deliberately so that the boys could see and learn just what Mr. Hanson says we cannot teach. Worcester does not like to be called too far behind and yet we are using jigs and fixtures more freely than the average shop in town.

I find that we fall short of having every tool of general utility that is advertised only to the extent of the following list: Bolt cutter; boring mill, vertical; multiple-spindle drill; radial drill; key seater; power press; automatic screw machine; slotter; thread-milling machine.

And all of these are on our list for future purchase. While I deplore the fact that there are, notably in the larger cities, a number of so called trade schools that have a very limited equipment and that pretend to turn out a machinist in a very limited time, I do not think it is fair to judge all the rest that are in operation or that may be put in operation by those few. For that matter I have every hope and sympathy for the small school, struggling along on a few lathes and a universal milling machine. The personal effort that a man, who is willing to handle such a school, can and will put into the boy will affect in a great measure the lack of variety in the equipment.

"The best trade school in my opinion is the shop itself, where the boy is all the time coached to make the work well, fast, and is also shown on what style of machine the work can be produced in the best and fastest manner." Here I agree with Mr. Hanson but I have never been so fortunate as to see these conditions in a shop devoted exclusively to making dividends, though I must confess that I have not had a chance to stop off in Hartford lately. If a shop will coach the boy as Mr. Hanson suggests, it will be splendid. That is just what we do in our shop, every day, but, if I had to look out for dividends I would see to them first and attend to the boys—well, some other time.

Worcester, Mass. E. H. FISH.

Shop Knowledge for the Mechanical Engineer

The last paragraph in the letter by George Stuart on page 268 is something of a mystery to me. I fail to understand how a boy is to become a mechanical engineer without knowing something of machine work. If he means that this is to be all secured *after* he graduates, the case is not so bad; but I firmly believe that it is better to get it either during or before the college course.

Few boys get the shop training before going to college. They lose the study habit and keep on working without going to school at all. Many cannot afford to stop to go to school.

Some get it after college but it is not easy. The pay seems small, they can make more in the drawing room and it is not always easy to come down to an apprentice's job after a college course.

When a boy can go to school first he knows what he wants to learn about. When he goes afterward, he has to unlearn many things that he supposed were true.

I well remember a mechanical engineer who came to us fresh from college. He was one of the brightest young men I ever knew and college had not hurt him as it does some. He had good ideas about machines and was a good designer except that he did not know the shop side, so he very naturally designed machines that were difficult or impossible to build with our equipment. Had he known a little about shop work he would not have made designs which were blunders from our point of view.

He was well "trained in mathematics, understood something of human life, could meet people," etc., but how could he, or anyone, converse on equal terms with a good shop man who knew just how the piece ought to be made? That is the part of Mr. Stuart's argument that I do not understand.

New York. JOHN R. GODFREY.

Human Nature and Praise in the Shop

I suppose Entropy thinks that last paragraph on page 51 is funny, but it isn't—it's *so*.

I have been for years looking for the man with the necessary intelligence to realize it, and the man with the "gumption" to put it into practice, to get together.

Cleveland, O. STRAWBOSS.

Brutality in Design

The article "Brutality in Design," on page 1176, Part 1, Volume 33, is short but full of meat. The argument there is in favor of abundance of metal to insure strength, ample and excessive.

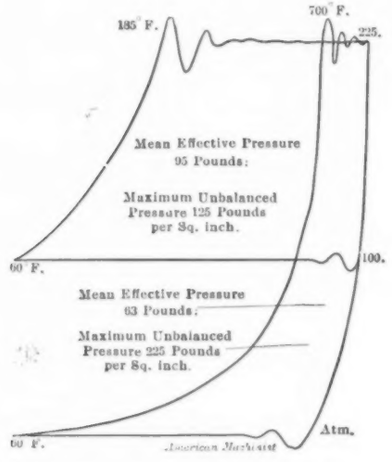
Before accepting this conclusion, however, it may be well for a moment to consider the other side of the question. In designing a machine of which only one is to be built, there can be no question that ample strength, even to the excessive use of metal, is the correct thing. But, on the other hand, consider the designing of a staple machine, a turret lathe for example, which is to be repeated in quantities of, say, one or two hundred a year. In such a machine reliability does not consist alone in strength; other qualities are essential, such as accuracy, sensitiveness, quick movements of parts, ease of adjusting cams and ability to quickly change from handling one piece to another.

If in designing such a machine the "Brutality" idea is followed, the result will be clumsy, ungraceful, sluggish in motion and, worst of all, the unnecessary weight and strength will continue for years and never be discarded. Is it not better, then, in such a case, to aim at just strength enough, even taking some chance on the side of weakness? Then, when the first few machines are made and put into operation, the weak points will become manifest; these can be strengthened and the result is a machine, graceful, sensitive, active in motion, not an ounce of unnecessary metal employed, a delight to the eye as well as to the pocket book, the very *ne plus ultra* of design. JAS. DANGERFIELD.

Dayton, Ohio.

Testing Locomotive Pop Valves

The letter of E. J. Buckbee, under the above heading appearing on page ???, is especially interesting to one accustomed to compressed-air calculations. In the arrangement described, the air pump receives air at 100 pounds pressure and increases this to 225 pounds pressure in another tank, the object of the high pressure being to assist the pump. The curious thing about this is that the mean effective pressure developed in the air cylinder of the pump, and consequently the mean resistance of the piston, is half again as high when receiving air at 100 pounds pressure as it would be if it were drawing from atmosphere. This would mean that if the pump were of the flywheel type, it would run with less effort if drawing from the atmosphere, than if receiving air at an initial pressure



AIR INDICATOR DIAGRAMS, SHOWING EFFECT OF HIGH INTAKE PRESSURE

of 100 pounds. From this it must not be inferred that it takes more work to fill the second tank with air at 225 pounds pressure when the pump intake is supplied with an initial pressure of 100 pounds, than it would take if drawing from atmosphere; it simply means that the *average* piston effort when drawing from atmosphere would be much less than when drawing from 100 pounds, although the pump would have to work a longer time to fill the second tank when drawing from atmosphere than it would if drawing from the higher initial pressure. The reason for this is that when receiving air at 100 pounds pressure, the air handled in the cylinder is much denser and therefore the mean effective pressure or the work per stroke is much greater, though fewer strokes will have to be taken. The appearance of the indicated diagrams in the two cases is seen in the line cut and it will be noted how much more nearly rectangular is the diagram when pumping from the high initial pressure than when pumping from atmosphere.

While the *mean* effort would be much less when drawing from atmosphere, it is a fact that the *maximum* effort at the end of the stroke would be almost double and it is at this point that the pump would stall in the absence of a flywheel, unless assisted by the high-pressure inlet, as actually used. The employment of a flywheel on the pump would carry it over these high peak points at the end of each stroke, and the actual work performed per stroke would be less when drawing from atmosphere.

To get down to figures; the mean effective pressure developed when drawing from an initial pressure of 100 pounds and discharging at 225 pounds, would be about 95 pounds per square inch, while if drawing from atmosphere and discharging at 225 pounds, in a single stage, the mean effective pressure developed would be only 63 pounds. With a 7-inch piston, the mean total piston effort with the high intake pressure would be about 3650 pounds, and with atmospheric intake this mean total load would be only 2425 pounds. At the end of the stroke, however, when drawing from 100 pounds, there would be a maximum unbalanced pressure of only 125 pounds per square inch, or a total maximum load of 4813 pounds, while if pumping from atmosphere, this maximum unbalanced pressure would, of course, be 225 pounds per square inch, or total maximum load of 8663 pounds.

While this is a curious state of affairs, it is clear to see that the employment of the auxiliary tank, giving the high inlet pressure, is an advantage, not only making it possible to use a pump without a flywheel, such as is already handy in a railroad shop, but considerable time and total work is saved by this means, in the final filling of the second tank, although this initial work is performed, of course, by some other air compressor in the shop.

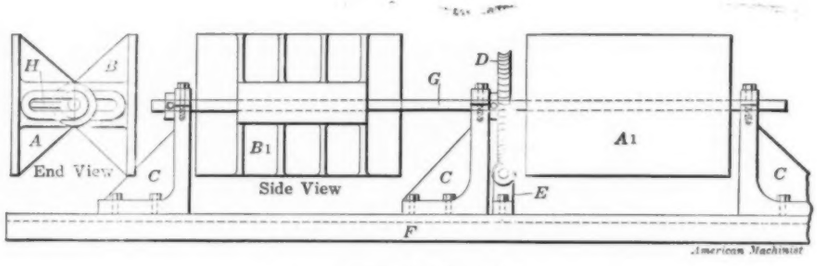
Aside from the question of work done by the pump, there is the even more important matter of temperature, especially with an unjacketed compressing cylinder. With 100 pounds inlet and 225 pounds discharge, the number of compressions is 2.09 and the final air cylinder temperature only about 185 degrees Fahrenheit, while if drawing from atmosphere there will be 16.3 compressions, giving a final air cylinder temperature of over 700 degrees. At such a temperature lubrication becomes a serious problem, as explosive gases often are formed by the action of the located air upon the oil.

New York City. S. B. REDFIELD.

How to Plane Those Castings

On page 1220, Part 2, Volume 33, appears a query as to how to machine certain pieces on a planer. The cut shows how the pieces may be done if the planer is large enough to swing them. But it seems to me that a large slotter would be about the proper thing to do the job on.

Referring to the cut, if there is a good-sized wormwheel and worm, and three large angle plates or brackets to be had around the shop anywhere, it need not be much work to rig up to do the job. *A* and *B* show the castings mounted on the shaft *G*, slid through the cored hole



PLANING THOSE CASTINGS

in casting and kept from turning by the wedges *H* driven tight between a cap resting against the shaft and the bottom of the slot. Small jacks or good sized bolts may be used. The castings are mounted on opposite sides, so that they will balance. The brackets *C* are bolted to the planer table *F*. The right-hand casting A^1 being machined, leaves the left one B^1 and the wormwheel *D* entirely out of the way of the tool. The worm bracket *E* being bolted to the planer table, the wormshaft may be used to arrange a feed, which may be a star feed or a ratchet may be put on in place of the star and arranged to feed from the table movement. I think a study of the sketch will make it clear just how to set up the job. If the cast holes through which shaft *G* passes is not accurate enough, a rough cut may be taken through with a boring tool. Should there be any difficulty from the work turning on the shaft *G*, it could have a spline cut the length of the shaft and keys fitted to it, making it impossible to shift.

EDMUND S. WILLIAMS.

Bridgeport, Conn.

Issued Weekly by the

Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROB'T MCKEAN, Sec'y.

505 Pearl Street, New York.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in United States, United States possessions and Mexico. $5.50 to Canada. $7 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

Hill Publishing Co., Ltd., 6 Bouverie St., London, E.C., will serve all subscriptions for English Edition for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

Published in the German language under the name of "Maschinenbau," by the Hill Publishing Co., m. b. H., 71 Unter den Linden, Berlin, N. W. 7. Price for Germany 24 M., Austria 29 K., Switzerland 32 Fr., other countries in Eastern Hemisphere 35 M., North or South America 40 M., or $10.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y. Business Telegraph Code.

CIRCULATION STATEMENT

During 1909, 1,209,000 *copies. For July,* 1910 *(American weekly, American monthly, English weekly and German weekly), total,* 111,250.

August 4	41,500
August 11	25,250
August 18	25,250
August 25	25,250

None sent free regularly, no returns from news companies, no back numbers.

Contents

PAGE

Making Cutters for Gear Teeth..... 333
Locating Indicator for the Miller..... 337
Repairing Rod Bushings..... 338
Use of Pressed Steel in Motor Cars.... 339
Cork Inserts as Applied to Machinery... 341
Constructive Industrial Education..... 343
Oil Burning Melting Furnace..... 345
Drilling Tests of a Plain Radial..... 347
Pickling Castings and Dips Used..... 348
Slide Rule in Screw Machine Work..... 349
A Firm Base for the Ink Bottle..... 350
Molding a Steam Turbine Cylinder..... 351
A Setting Device for Use on Planer..... 354
The New Customs Tariff of Japan..... 354
Card System for Shop and Store Room.. 356
A Stud Vise..... 358
Preserving Rubber Tubing, Etc..... 358
Letters from Practical Men:
A Tape Wrapping Machine....Removing Stubborn Wood Screws....Drawing Large Radii without Trammels....Objects to Catalog in Books....Table of Wire Areas....Boring a Large Cone....Oiling Sheet Metal for the Punch Press....Double Screw Machine Jobs....Stamping Cutting Tools....Mechanical Word Pictures 359-361
Discussion of Previous Question:
Another Stubborn Repair Job....Progress and Hustle....Training Apprentices in Trade Schools....Shop Knowledge for the Mechanical Engineer....Human Nature and Praise in the Shop....Brutality in Design 362-363
Success Depends on Individual Judgment 365
How Competition Helps to Sell Goods... 365
New Tools and Shop Appliances..... 367

American Machinist

Editorial

Success Depends on Individual Judgment

Nine out of ten, or even a larger percentage consciously or unconsciously follow the plans and methods laid down by others no matter what their line of work. It is easier to do so or, as the college professor would say, it is the line of least resistance and, therefore, the natural tendency.

If one shop in a town buys a certain kind of lathe and uses it successfully, other lathes of the same kind are very apt to find their way into the other shops, whether they are suited to their work or not.

The same thing is true of shop systems, of standardizing the shapes of cutting tools and a hundred other shop problems. We are too apt to adopt plans that suit other shops without carefully considering whether they meet our conditions or not.

The question of large or small shop orders is a case in point. In some lines of work and with good facilities it was found advisable to put the work through in very large lots. The economies of manufacturing in large lots became so apparent in these cases that smaller shops tried the same plan. Not having the necessary equipment, certain departments became overcrowded and the result was unsatisfactory as might be expected. There can be no empirical rule for the economical size of any shop order as it must be determined for each shop. It depends on the shop and on the product and must be decided by the judgment of the man in charge.

It is a good plan to know what other shops are doing in order to avoid getting into the rut of thinking that we have the only right way. But because the next man attains success by using a certain machine or a certain method is no assurance that we should follow in his footsteps.

The right machine or the right sized shop order must be determined by the judgment of the man in charge in view of the particular conditions he has to contend with. The methods which spell success in one case may invite the bankruptcy lawyer in another.

And after all, this is what makes the game worth the candle. If the right way to run all shops could be taught like the multiplication table, it would have a monotony that would be deadly. The exercise of individual judgment will always be necessary to real success in the management of any business. This judgment will be broader and better for knowing other methods, but it will prevent following them blindly.

How Competition Helps to Sell Goods

Competition is much more often a blessing in disguise than we are apt to realize. Not because we would never have improved machinery without it, but because it helps broaden the market for any machine when more than one concern is making it.

No good mechanic is ever quite satisfied with the machine he builds and he would keep on making it better and better if he were located in Kamchatka and no native ever complained at the old one. And, after building a good machine it is quite natural that there should be a feeling of resentment when others start in to build the same kind of a machine.

There is another side to the question, however, although it is very apt to be overlooked. Every new builder of an automatic screw machine, to use this as a concrete example, has helped to create a market for screw machines in general, by educating machine builders to see their advantages. Every salesman, silent or otherwise, helps to make people think of the possible advantages to be obtained by their use. True, the one who does the educating does not always get the order, but he has helped to swell the total of machines to be used.

Carrying this a little farther, we can see that it may be better at times, to let the other fellow sell a machine than to have none of them used in that shop. Even if it is a poorer machine, as, of course, it must be, it may whet their appetites for a really good machine next time and they will appreciate it all the more when they do get it.

It takes considerable philosophy to look with equanimity on the loss of a sale to a rival machine, and yet seasoned salesmen can recall instances where this was the best thing that ever happened to them. When they did get their machine in, they made such a showing as to make future orders easy.

If we can get into the habit of looking at this in the broader way, of realizing that, in the long run they all help the best machine to win, we can do business in a more comfortable state of mind. And we will not be so disturbed at the advent of a new competitor as is apt to be the case.

A Lesson from the Panama Canal

At the time when the Panama canal was undertaken by the United States Government some pessimistic person called attention to the fact that up to that time no work of magnitude had been accomplished under the tropic sun except by slave labor and with an absolute disregard of the value of human life. The pyramids of ancient time and the Suez canal of more recent date were cited as examples, and the prediction of failure or the use of the lash was made.

How far wrong this prediction happens to be is now pretty well known. Unprecedented quantities of dirt are being moved under conditions that would be a credit to any portion of the world and with a death rate notably less than occurred among the nonworking natives before the canal was undertaken.

Men have been enabled to work in spite of the heat simply by being given decent sanitary surroundings.

This has been strictly an engineering feat. There has been nothing but a straightforward attempt to make life worth living in a strip of land across the isthmus where before nothing but noxious, poisonous animals and plants found harbor.

As an engineering triumph it stands as a greater work than the building of the canal itself, for it shows the world what can be accomplished under the most adverse surroundings. And the little that needs be done, but needs to be done so badly all through the temperate zone, is so easy if only proper engineering talent is allowed to get at it.

New Publications

Metal Spinning. By D. Tuells and William A. Painter. Thirty-eight 6x9-inch pages, with 45 illustrations. The Industrial Press, New York. Price, 25 cents.

The development of the power press in the working of sheet metal has absorbed attention to an extent that has caused spinning as a manufacturing process to drop into the background. Nevertheless, there is, and always will be, a field of operation for this process, which, in addition to its merits, possesses a degree of interest second to that of no other mechanical operation.

The present pamphlet is a reproduction of three articles which appeared in the pages of our contemporary, *Machinery*, during the early part of the present year. It gives clear and adequate explanations of the principles of spinning, and clearly describes and fully illustrates the tools and methods used.

The Engineering Index Annual for 1909, Compiled from the Engineering Index of the Engineering Magazine. Four hundred and seventy-one 6x9-inch pages. The Engineering Magazine, New York and London. Price, $2.

The annual summary of the index department of the *Engineering Magazine* has now become such an integral part of engineering literature, which one expects to acquire as a matter of course, that its appearance calls for little more than an announcement of the fact.

The engineering profession is to be congratulated that the index enterprise is a paying one, because that fact insures its continuation. We are glad to know that the demand for the book shows a substantial increase as the years go by. There is no more important service to the engineering profession than that done by the *Engineering Magazine* in the preparation of this index.

The Mechanics' Handbook. By International Correspondence Schools. Seventh Edition. 330 3½x5¼-inch pages, with numerous illustrations and tables. The International Text Book Company, Scranton, Penn.

The most difficult of all books for a reviewer to handle with satisfaction to himself are engineers' and mechanics' pocket books, of which in general it may be said that there are very few that are not well worth their price. One of the features of the publication under notice, wherein it differs from most others, lies in the fact that it gives adequate explanations of the uses of many of the tables. Thus, we find an 18-page description of the principles and uses of logarithms with an adequate number of illustrative examples and a 6-page explanation of the uses of the tables of trigonometric functions. There is also a 10-page illustration of the uses of formulas and a 6-page explanation of powers and roots. A considerable portion of the book relates to the design of various machine elements, which are treated in the usual way, with drawings and simple formulas. There are also sections on electricity, surveying, and railroad track work.

A History of the Logarithmic Slide Rule and Allied Instruments. By Florian Cajori. One hundred and thirty-six 5x7¼-inch pages; 17 illustrations. The Engineering News Publishing Company, New York. Archibald Constable & Co., Ltd., London. Price, $1.

Few users of the slide rule can have failed to feel at least some curiosity regarding the origin of the instrument, while to those having the historical sense the meagerness of available information regarding the history of the instrument has long been a source of regret.

The present volume is the result of a good deal of historical investigation, which has borne fruitful results regarding the early history of the slide rule, about which many erroneous statements are current in such historical sketches as exist. Professor Cajori seems to have succeeded in definitely assigning credit for nearly every important step in the development of the instrument—and there are more such steps than the simple nature of the slide rule as made today would lead one to expect. The book is of decided interest as well as merit, and the painstaking labor behind it deserves recognition by a suitable sale among the numerous users of slide rules.

Ohio Valley Exposition

A general industrial exhibition, in which nineteen States of the Ohio valley and South are to be represented, is to be in operation in Cincinnati, O., from August 29 to September 24, 1910.

The exhibits are to have a wide range and the program of events promises a highly interesting review.

Obituary

Albert Spies, who for many years was editor of *Cassier's Magazine*, and recently proprietor and editor of the *Foundry News*, a newly established trade paper, died at his home in Jersey City on August 16.

Mr. Spies was a Stevens Institute graduate, a member of the American Society of Mechanical Engineers, and a well known figure in technical journalism.

Personals*

E. F. Ryerson, president of Joseph T. Ryerson & Son, Chicago, Ill., has sailed for a several months' trip through Europe.

M. W. Case has been appointed superintendent of the Champion Machinery Company, Joliet, Ill. Mr. Case was formerly chief draftsman for his company.

Robert H. Grant has recently become manager of the ball department of the Grant-Wood Company, of Detroit, Mich., being located at the Chelsea, Mich., plant.

W. E. Robbins, for several years employed in the factory of Irving Coles & Co., Worcester, Mass., has been appointed manager of the New York office of his company.

*Items for this column are solicited.

New Tools and Shop Appliances

New Model High Power Vertical Milling Machines

The engravings illustrate the new-model, high-power vertical milling machines built by the Becker Milling Machine Company, Hyde Park, Mass. These are made in several sizes, the models A and A B, referred to particularly here, being the smallest of the line.

In the development of the new line of machines, the makers have striven to produce the highest possible efficiency with the use of the direct belt-driven spindle. For the heavier cuts they have adopted the simplest form of direct-connected back-geared spindle, and with large spindle-driving pulleys and high belt velocity they are able to do with direct open belt-driven spindle the greater amount of their work, using the back gears only on the heavier cuts. The direct belt drive or the drive through direct-connected gears practically obviates the progressive development of back lash between gears.

As will be seen from the general views, Figs. 1, 2 and 3, the mechanisms requiring lubrication are outside the column,

ANY and all new or improved machines, tools, or shop appliances of interest to men responsible for results in machinery-making plants will be briefly illustrated and described here—the machine shop news.

A more full and detailed description will be given—when it is real news—if it can appear here first—before it is sent to other papers. All descriptions appear in ALL four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.

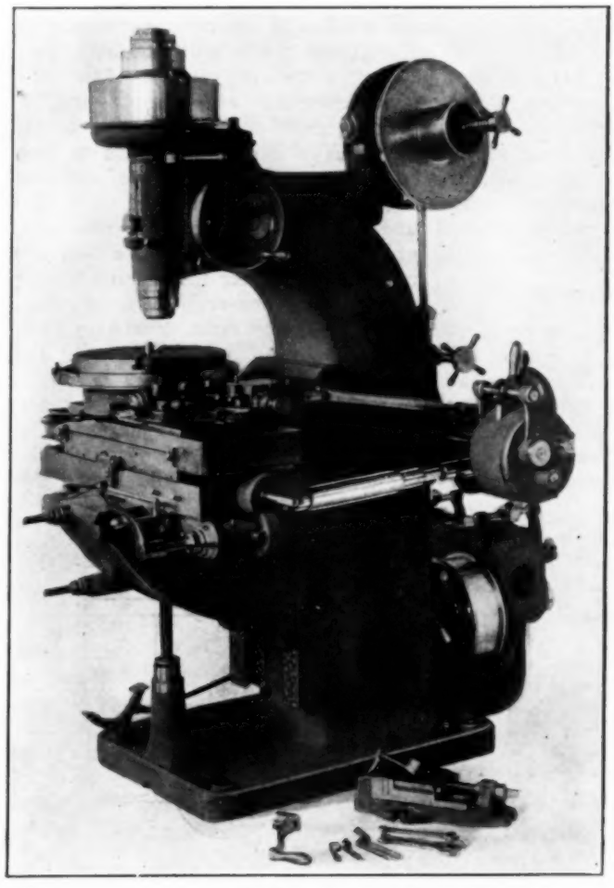
and all working parts are easily accessible. The feed changes are made while the cutter is working, thus enabling the operator to adjust the feed accurately with the work under the cut.

General Construction

The knee is of rigid construction and the wearing surfaces are very broad. The sides are double walled, the outer wall extending slightly beyond the edge of the dovetail, thus offering protection from careless handling of heavy castings. The method of securing the knee to the column insures permanent alinement with the spindle, and adds greatly to the general rigidity of the machine.

The rigid proportions of platen and saddle made necessary by the requirements of modern milling practice are well brought out by the illustrations, which also show the long support provided for the table, the saddle and table being so proportioned as to insure uniform wear of the sliding surfaces. These surfaces are protected from chips by rolling aprons.

The cutter head has ample movement vertically, and the larger sizes, models B,



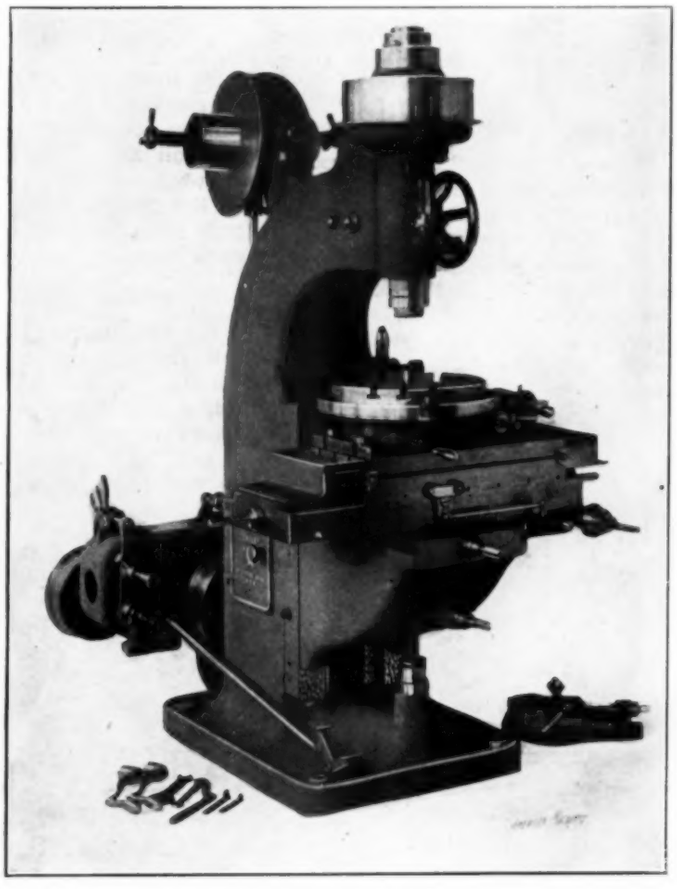


Fig. 1 Becker New-model High-power Vertical Milling Machine Fig. 2

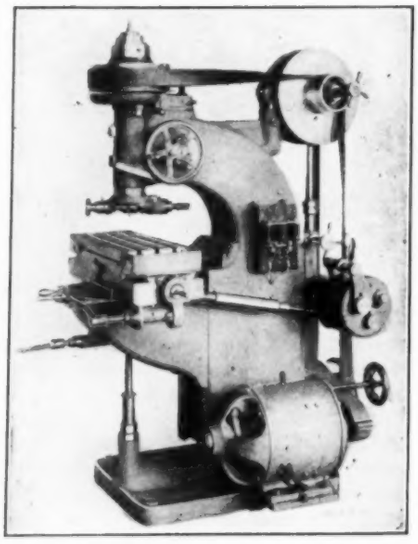


FIG. 3. VERTICAL MILLING MACHINE WITH MOTOR DRIVE

C and D, have automatic vertical feeds, thus adapting them for vertical boring. The spindle is carried in a conical sleeve bushed with bronze bearings, and provided with means of adjustment for wear. The end thrusts are taken upon standard roller bearings capable of sustaining heavy pressure and supported upon the ends of the conical sleeve. This construction prevents possible seizure of the spindle incidental to unequal expansion of bronze and iron. A rigidly supported stop gage is conveniently located directly in front of the spindle.

CONSTANT-SPEED PULLEY DRIVE

The new-model machines are provided with constant-speed driving pulley, but when preferred models A, A B and B are furnished with cone-drive countershafts. The constant-speed gear box provides seven changes of spindle speeds. This gives models A B and B, with back-geared head, 14 spindle speeds, ranging from 20 to 395 revolutions per minute, while models C and D, double back-geared, have 21 spindle speeds.

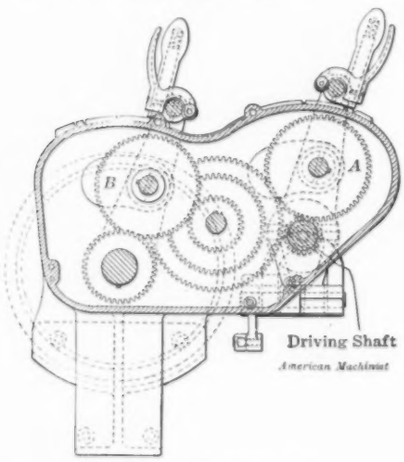


FIG. 4. SPEED GEAR BOX

The spindle-speed gear box is of very simple construction. As shown in Fig. 4, there are two tumbler gears *A* and *B* both engaging the same central gear shaft, on which are mounted three gears. When both tumbler gears engage the same gear an intermediate speed is obtained. By driving on one and off another gear on the three-geared shaft, various speeds are obtained in uniform progression. An

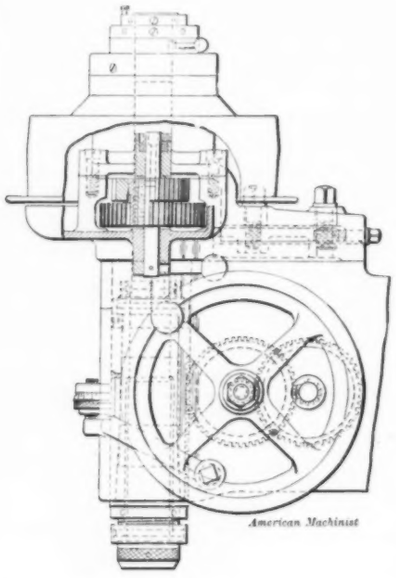


FIG. 5. ARRANCEMENT OF SPINDLE BACK GEAR

index attached to the gear box indicates the speeds and the proper position of the tumbler gears to obtain them.

On all sizes of these machines, seven open-belt spindle speeds are available for lighter cuts. The arrangement of the back gears for the spindle will be understood from Fig. 5.

THE GEAR FEED-CHANGE BOX

The feed gear box, shown in the general views of the machine and in the drawing, Fig. 6, is a simple device, providing from two to three main changes according to the size of the machine. It is used when changing from very light to very heavy milling, from extremely

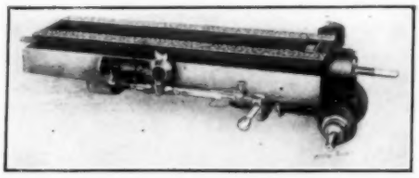


FIG. 7. AUTOMATIC REVERSING TRIP FOR FEED

fast table feeds to very slow movements, or when changing from open-belt to back-geared spindle drive. The method of operation will be clear upon inspection of the line engraving. No internal lubrication is necessary. The sliding gears are fast on their shafts, and the bearings are outside of the gear case. The main changes of feed are made without stopping the machine. The regular feed changes, which are infinitesimal, are made with the friction disks, giving a minimum of 1/64 inch and maximum of 1½ inches per revolution of cutter on models C and D. On the smaller machines shown the feeds range from 0.003 to 0.250 inch per revolution of cutter.

THE FRICTION FEED AND HOW IT WORKS

The friction-feed disks are shown plainly at the top and rear of the column in Figs. 1, 2 and 3, and the vertical shaft by which they drive the mechanism in the gear box, Fig. 6, is also shown in the different views. In this design advantage is taken of the natural tendency of driving belts to ride up to the high portion of a crowned pulley. This tendency, combined with correct angular mounting of the axes of the idler cones, automatically causes the disks to hug the driven cone of the vertical shaft to a greater or less degree, the stress depending upon the degree of resistance encountered by the spindle in driving the cutter. The heavier the cut the harder will be the pressure upon the driven cone, the degree of pressure depending upon the rise and fall of the belt upon the driving disk cones caused by the varying resistance of the cutter as it is being fed into varying depths of the cut. The greater the resistance the more will the belt tend to ride up to the larger dia-

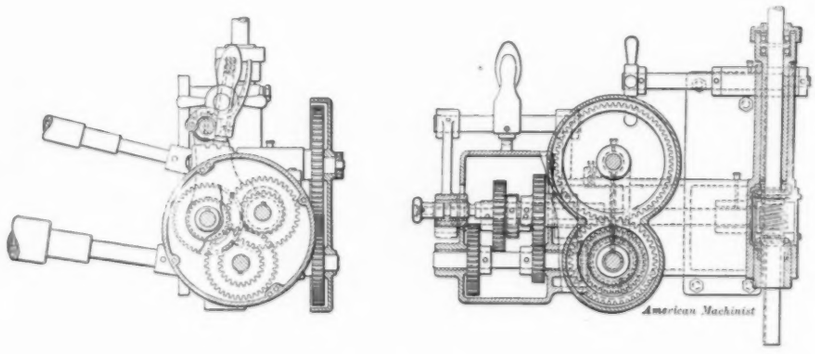


FIG. 6. THE FEED GEAR BOX

meter of the cone, thus tightening the belt.

When long pieces are rough milled, requiring a light finishing cut on the return, and when readjustment of the cutter is unnecessary, a tripping device can be supplied that can be set at either end of the feed, to automatically reverse and stop the feed at the starting point. This device will answer the purpose of regular tripping dogs which throw out the feed at the end of the stroke without reversing.

The Rotary Attachment

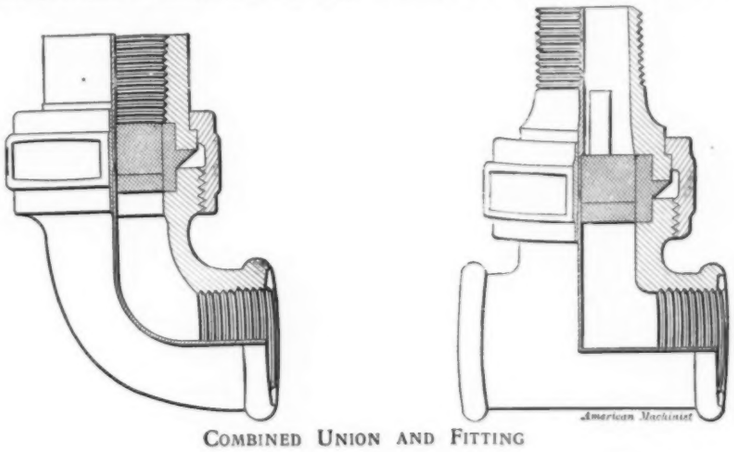
The rotary attachment shown in Figs. 1 and 2 is driven direct from the feed gear box through an independent universal shaft, also seen in Fig. 6. Automatic trips are provided to throw out the feed in either direction. The worm can be thrown out of engagement while running and the table quickly returned to its starting point.

This device, as illustrated in Fig. 3, is neatly and rigidly attached to the head of the machine. The advantages of this accessory will be readily appreciated. It swivels in a complete circle, and can be firmly locked in any position. Cutters at the end of the spindle are secured by a drawing rod. Mills can also be used in the center of the arbor or spindle, this being provided with means for adjusting the cutter accurately in line with the center of the main spindle when using it in combination with the automatic universal head in milling worm threads or similar work. This combination of horizontal spindle and universal head makes this vertical miller a practical tool-room universal milling machine.

The machine in Fig. 3 is represented as equipped with a Reliance 2-horsepower variable-speed motor, having a 5 to 1 speed variation, ranging from 400 to 200 revolutions per minute. The motor is geared 4 to 1 to the machine and the spindle speeds obtained range from 37 to 500 turns per minute. It will be evident that with this form of drive and the variable-feed mechanism, practically any combination of feeds and speeds desired can be obtained at once.

A New Line of Unions

The accompanying illustrations show two of a new line of unions now being made by the E. M. Dart Manufacturing Company, Providence, R. I. These are simply an adaptation of its regular union, having two bronze seats and used in connection with the regular forms of pipe fittings. Although only an elbow and a T are shown, these can be made in any desired combination, the bronze joint being at any opening of the fitting, and the coupling either male or female as desired. They have the strength of iron-pipe fittings in the pipe end, are made with strong nuts, substantial shoulders and in heavy patterns.



Combined Union and Fitting

New Cincinnati Milling Machine

The illustration shows the latest machine of the Cincinnati Milling Machine Company, Cincinnati, Ohio, which has been developed for such work as can be best handled on a cone-driven machine. While still advocating the single-pulley or all-geared machine for heavy work, it realizes the wide field for cone-driven machines and has redesigned its entire line, as can be seen from the illustration.

The feed changes are obtained from a single group or unit mechanism, mounted in the column, high enough from the

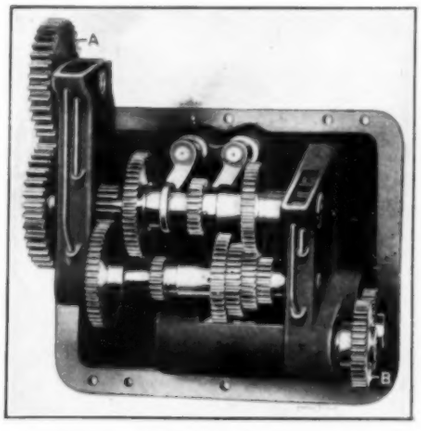


Fig. 2. The Feed Mechanism

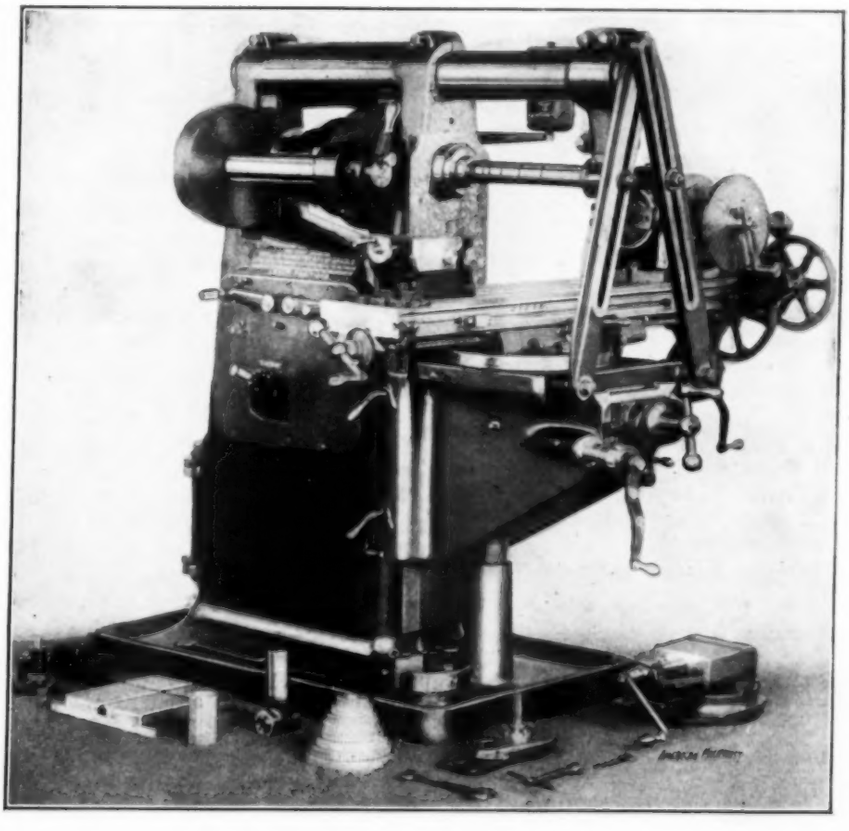


Fig. 1. New Cincinnati Milling Machine

floor to bring all levers and the index within easy access of the operator. The inside of the feed-mechanism unit is shown in Fig. 2 and provides 16 changes of feeds, ranging from 0.007 to 0.300 inch per revolution of the cutter, these changes being secured by only 12 gears, as shown. The drive is direct from the face gear on the spindle through the gear *A*, while the last gear of the train *B* drives the universal jointed shaft. The three handles on the outside of the box give all the changes, there being four positions of the lower handle and two positions of each of the others.

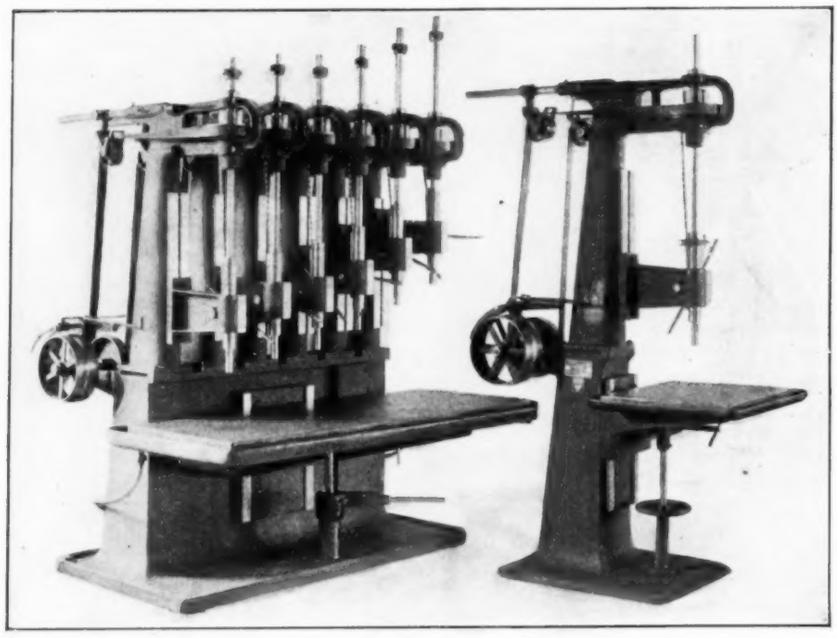
Perhaps the most striking feature of this design is the construction of the tumbler mechanism. This tumbler is made in the form of a cylinder of large diameter, which supports the tumbler shaft and gear. This is in itself supported in the frame of the feed box, a construction which obviates all bending of the tumbler shaft, as well as vibration in the tumbler itself. Although the tumbler lever projects through a hole in the feed box in the usual way, this opening is completely closed at all times, owing to the cylindrical form of the tumbler, and in this way thoroughly protects the inside mechanism from all dirt.

A Thread Milling Cutter

The milling cutter, designed by Chas. E. Klink, Kingston, Penn., and described at page 184, is specially adapted for thread milling.

Automobile Manufacturers' Ball Bearing Drilling Machines

The Henry & Wright Manufacturing Company, Hartford, Conn., has designed a new line of drilling machines intended especially to handle the variety of work necessary in the manufacture of automobiles and in kindred modern manufactures. These drills contain the important features of its smaller machines and some new ideas which add greatly to their practical value. Two of the machines are shown in the accompanying halftones. They are very much heavier and more rigid, fully equipped with ball bearings, and have power sufficient to drive high-speed drills efficiently from 1⅛ inch down to the smallest sizes.



AUTOMOBILE MANUFACTURERS' DRILLING MACHINES

The ball bearings are made interchangeable and may be readily renewed.

The spindle drive is at the lower end of the spindle pulley, giving a more rigid drive to the spindles. The drive is incased to exclude dust and retain oil. The accurate drilling or counterboring to a spindle pulley is supported above and below the belt, thus relieving the spindle from all strain due to belt pull, insuring accuracy at the drill point.

The spindle sleeve has an inserted steel rack and adjustable stops are furnished as ordered to fit either the spindle at the top of the pulley or the rack. For accurate drilling or counterboring to a specified depth, the latter is recommended.

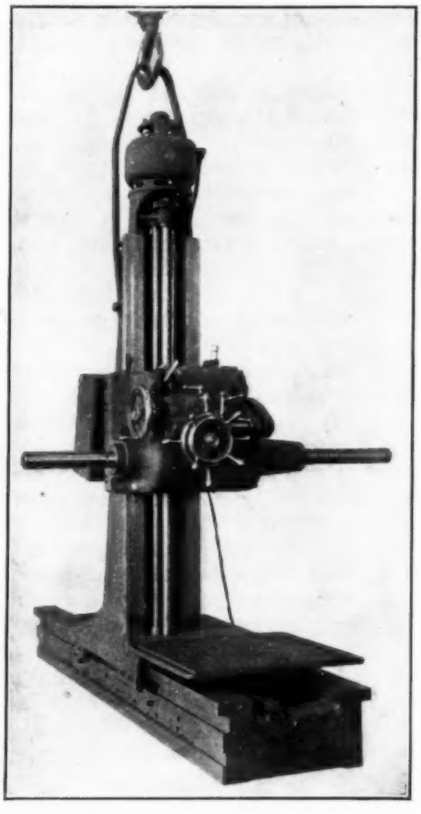
The machines are entirely belt driven and are made with from one to six spindles each and in three overhangs, 8, 12 and 15 inches. The spindles are driven with an endless belt 1¼ inches wide, and the rear shaft is driven by a 2½-inch belt. The wider belt driving the rear shaft is designed to furnish sufficient power to enable two operators to work on the same machine when desired, and individual spindles may be started or stopped independently. The limit of accuracy of the spindles is 0.002 inch in an 8-inch circle.

The tables are very heavy, have wide and long ways and are equipped with elevating screw; additional support is furnished by two supporting jacks at the outer corner of the table. The oil grooves around the tables are amply wide and deep and both ends may be fitted with tubing to connect with an oil tank inside of the base. A rim is cast around the foot of the base to prevent oil from flowing off the machine to the floor.

The raising screw of the No. 6 machine is fitted with a ratchet lever instead of the usual handwheel to facilitate the raising and lowering of the heavy table. The distance between the spindle centers on the No. 6 machine is 10¼ inches. The greatest distance between the spindle end and table top is 30 inches. The table surface is 75x24 inches and the net weight of the complete machine is 5500 pounds.

Rochester Portable Boring Machine

The illustration shows the head and face of the Rochester floor boring machine equipped so as to be readily



ROCHESTER PORTABLE BORING MACHINE

handled by the crane and moved to any part of the shop desired.

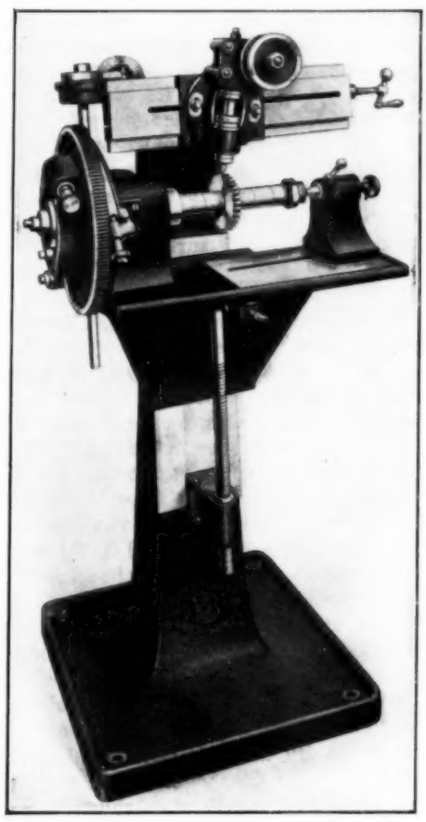
It is provided with screws for pushing the head away from the floor plate which forms part of the machine, so as to draw out the dowel pins which are provided for locating it in any desired position with relation to this floor plate.

This makes the machine equally applicable for either stationary or portable work, and will be found very convenient in many places. The details of the machine were fully described at page 1177, Part 1 of the current volume.

A New Automatic Tooth Rounding Machine

The halftone shows a new automatic tooth-rounding machine, built by Schuchardt & Schutte, New York City. This machine is designed to economically chamfer the teeth of gears for all classes of work, and is especially adapted for handling such gears as are commonly used in sliding transmission.

The machine uses a profiling cutter, carried in a spindle mounted in suitable bearings on the cross rail of the machine. This spindle can be swiveled to angles



TOOTH-ROUNDING MACHINE

suitable for any gear tooth. Motion is transmitted to the spindle carriage by means of box cam, which moves the spindle head crosswise on the cross rail. The arbor, which carries the gears that are to be operated on, is reciprocated by means of a large indexing gear, which is controlled by change gears which time it in accordance with the number of teeth in the gear that is being operated on. This motion is entirely automatic and dispenses with individual indexing, the operation being continuous from the start of the gear until its finish.

The machine will handle either a single gear or several at a setting. Gear teeth can be rounded on both sides, at the same setting; for rounding the teeth of crown gears a special attachment can be furnished. Running the machine at its normal speed (1000 revolutions per minute of cutter), it will round on the average fifteen 6/8 diametral-pitch teeth in nickel-chrome steel per minute.

The column of the machine is of the box type, provision being made at the rear of the column to accommodate the change gears. The machine will handle gears up to 12 inches in diameter. The countershaft furnished with this machine is provided with self-oiling bearings, having chain-oiling device. Net weight of machine, 1300 pounds; floor space, 26 square feet.

Universal Micrometer Caliper

The halftone engraving, Fig. 1, illustrates this micrometer clearly, and Fig. 2 shows numerous applications to different classes of work. In the design of the tool there has been no attempt to retain

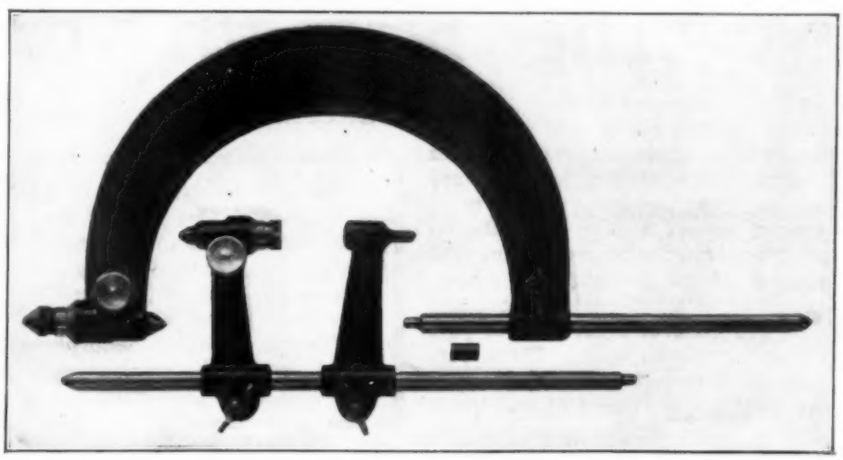


FIG. 1. UNIVERSAL MICROMETER CALIPER

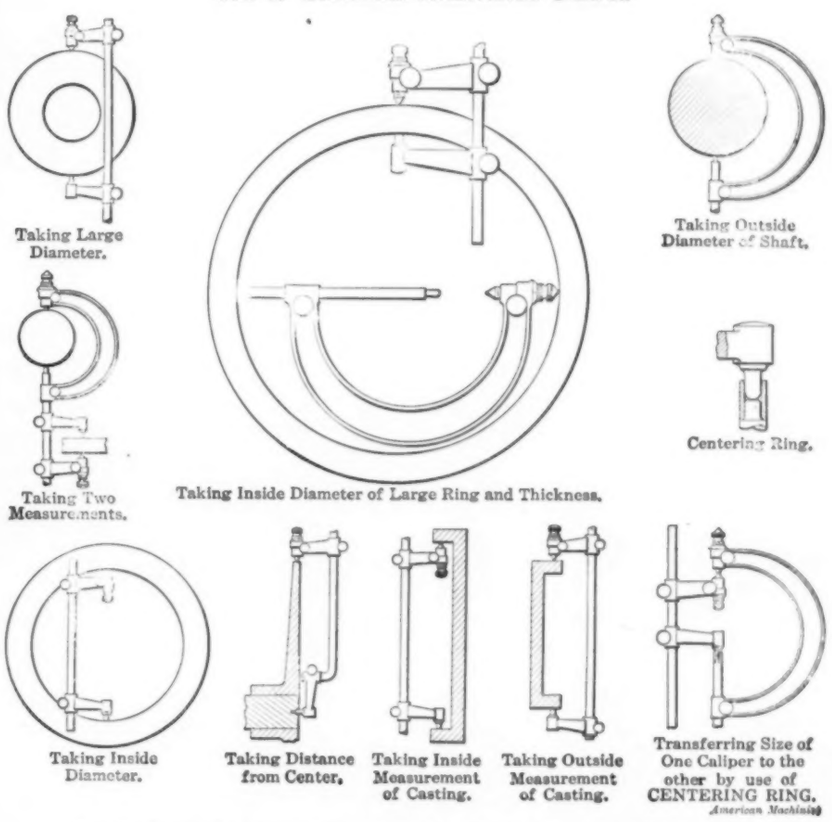

Taking Large Diameter.
Taking Outside Diameter of Shaft.
Taking Two Measurements.
Taking Inside Diameter of Large Ring and Thickness.
Centering Ring.
Taking Inside Diameter.
Taking Distance from Center.
Taking Inside Measurement of Casting.
Taking Outside Measurement of Casting.
Transferring Size of One Caliper to the other by use of CENTERING RING.
American Machinist

FIG. 2. SOME APPLICATIONS OF THE UNIVERSAL MICROMETER CALIPER

the reading measurements of the ordinary micrometer, but simply to produce a caliper with a wide range of applications in producing duplicate parts or fits of various kinds and one where positively known allowances can be made. The micrometer consists of a drop-forged frame with a sliding rod in one end for quick adjustment and a micrometer screw in the other for fine adjustment and allowance. Both adjustments are securely locked when set. It has a range of four inches inside of the frame. The micrometer screw and sliding rod have convex ends. It can therefore be used directly on running work in the lathe the same as a pair of calipers. The same arc member may also be used as an inside caliper from seven inches to thirteen inches with the regular rods, or by using longer rods an inside diameter of several feet may be calipered.

There are also two drop-forged arms about two inches in length which are adapted to slide on the rod. One of these arms is fittted with a micrometer screw graduated in thousandths and the other with a tool-steel pin having a convex point. These arms are reversible and can be used as either inside or outside calipers. They may be used on the tool proper for carrying two measurements at one time or applied to a separate rod for either inside or outside work. For transferring from one to the other there is a centering ring which holds two of the points in contact and in alinement with each other while the micrometer screw on the caliper being transferred to, is adjusted to touch. By this means the setting is transferred quickly and accurately. After the transfer is made the graduated micrometer screw is used to make positive allowances in thousandths for any desired fit. All contact points are tool-steel hardened.

The micrometer is manufactured by Gilbert, Harris & Co., Chicago, Ill.

New High Strength Nonferrous Alloy

Editorial Correspondence

An alloy composed of 75 per cent. cobalt and 25 per cent. chromium that can be given the strength, hardness, ductility and cutting qualities of steel and is also noncorrosive.

The effect of acids, atmosphere and heat upon the metal and some tests that it has been given.

Ellwood Haynes, of Kokomo, Ind., has recently brought out a new nonferrous alloy that is composed of cobalt and chromium. It is claimed to have many desirable properties and promises to be useful in various ways. It was the result of a long series of experiments with nickel, cobalt and chromium.

The first piece of any size that was made, was made of equal parts of pure chromium and pure cobalt. These were placed in a carbon crucible lined with pure magnesia and fused in an electric furnace. It was cast into an ingot ¼ inch square by 5 or 6 inches long. This seemed to be quite brittle as it was difficult to draw, under the hammer, without cracking it.

A gas furnace was then used to make an alloy containing 75 per cent. cobalt and 25 per cent. chromium. This was melted in a crucible that was made of a very refractory material and the alloy melted to a perfect fluid and poured into an ingot ½ inch square and 5 or 6 inches long. This metal proved comparatively ductile, and by careful hammering it was forged into a rough strip.

Qualities of Metal

By adding various purifying materials a very tough and malleable alloy was made, which, when heated to a bright red, was hammered into very thin sheets without showing any signs of cracking. A razor blade was made from it that has been used hundreds of times for shaving without any appreciable signs of wear.

Tests of the metal showed a tensile strength of 96,000 pounds, an elastic limit of 97,000 pounds and an elongation of 3 per cent. This is slightly better than the tensile strength and elastic limit of untreated steel and more nearly approaches that of good nickel steel. The modulus of elasticity was found to be equal to that of steel, which is a result that has never hitherto been obtained in the nonferrous alloys, as they were so low as not to be compared to iron and steel.

Like the iron or steel products, small quantities of other materials mixed in the alloy modify or alter its properties to a remarkable degree. For instance, combinations or alloys have been obtained which were very brittle yet would readily scratch quartz crystal. By slightly reducing the percentage of chromium and adding small percentages of other material, alloys were obtained that were practically proof against nitric acid and also sufficiently soft and malleable to be worked cold, these having a hardness but little greater than mild untempered steel.

Cutting and Bending Tests

A number of combinations suitable for many different purposes can be made between these two extremes. An instance of this is a bar that was made into a cold chisel ¼ inch thick, ½ inch wide and 3 inches long and then used to cut in two a 20-penny wire nail. The edge of this chisel was not marred in the slightest degree.

Another alloy was made into a lathe tool ¼ inch square and 3 inches long and this showed cutting qualities comparable to high-speed tool steel.

The alloy composed of 75 per cent. cobalt, 25 per cent. chromium and small quantities of other metal can be made sufficiently hard for good edged tools, but is also tough and can be bent much beyond its elastic limit without cracking. In this respect it resembles the alloy steels, but, generally speaking, is much harder. A 1¼-inch square bar can be bent cold at right angles without showing any signs of cracking.

Its color is between that of steel and silver. The alloy is readily polished but requires special treatment to develop its highest luster, which is pleasing to the eye in a bright light. Its resistance to corrosion is only equaled by gold and the metals of the platinum group. This alloy, therefore, gives us a metal that is noncorrosive and has the strength of steel, with a hardness that is sufficient to give tools a good cutting edge.

Effect of Acids

It is attacked slowly by dilute hydrochloric acid and somewhat vigorously by the strong acid, especially when heated. Momentary exposure, however, to either the diluted or strong acid has practically no effect on the metal. Both strong and diluted sulphuric acid attack it slowly when cold and not very rapidly when heated. Nitric acid is totally without any action upon it and a polished piece may be boiled in it for hours without affecting the luster of the metal in the slightest degree.

Solutions of the caustic alkalis have no action on the metal even when boiled for hours. It is also proof against all atmospheric influences whether the air be moist or dry and the metal retains its brilliant luster for months under the severest conditions. Even sulphureted hydrogen does not affect it when present in the atmosphere in large quantities.

Effect of Heat

When the metal is heated in contact with the atmosphere, it retains its color up to a dull red heat or about 900 degrees Fahrenheit. At this point it shows a faint straw color which deepens as the

temperature rises and passes through bronze, yellow, purple and blue and finally terminates in blue black. The film of oxide does not seem to increase in thickness after a prolonged heating and the alloy shows no scale even when heated to a bright orange.

The 75 per cent. cobalt and the 25 per cent. chromium alloy can be melted in an open crucible in a gas furnace with an oxidization loss of less than ½ of 1 per cent., providing a slightly reducing flame is maintained. This seems remarkable on account of the high melting point, which is about 3000 degrees Fahrenheit.

When the mixture is heated to whiteness in the crucible, the cobalt first commences to fuse and immediately begins to combine with the chromium. When the metals are mixed in the proportions of three parts to one part, by weight, a eutectic is formed that seems to possess a lower melting point than either cobalt or chromium.

For cutlery of various kinds and surgical instruments, the alloy could be made very useful owing to its noncorrosive and edge-holding properties. Its hard, lustrous and untarnishable properties make it well adapted for the manufacture of fine weights, scrapers, spatulas and other laboratory appliances, as well as for measuring instruments and various small tools. With more investigation many other uses may also be found for the metal.

The International Inventor is the name of a new publication which made its first appearance with the issue of July, 1910. This is a publication in the interest of investors, patents, and international expansion of industries. Richard F. Hamilton, familiarly known as "Tody" and formerly the well known advertising manager for Barnum's circus, is the editor. It contains about 20 pages of the standard 9x12 size, and the subscription price is $1.50 per year. It is published in the Tribune building, New York City.

Increasing Shop Capacities

Metal Working

News items for the sales department—where more equipment will be needed. Authentic news is solicited for this department, not rumors or gossip—facts.

The Canada Metal Company will build a factory at Winnipeg, Man.

The Northwestern Steel Works, Eau Claire, Wis., will erect a foundry.

J. McKay, Cochituate, Mass., is in the market for band-sawing machinery.

The Phœnix Iron Works, Portland, Ore., is erecting a two-story foundry.

Burt & Holzcheiter, 934 Hastings street, Toledo, Ohio, will erect a foundry.

The Union Malleable Iron Company, East Moline, Ill., plans to expand its plant.

Fire did $2500 damage to the plant of the Banting Machine Company, Toledo, Ohio.

The Lisbon (Ohio) Auto Truck Company is being formed. A new plant is to be built.

Hemp & Co., St. Louis, Mo., stove manufacturers, will erect a new $100,000 plant.

The Cleveland (Ohio) Automatic Machine Company will build an addition to its plant.

The McKinnon Dash Metal Company, St. Catharines, Ont., is erecting a large building.

The Dominion Bridge Company is building large additions to its plant at Winnipeg, Man.

The Small Motor Company, of Detroit, Mich., will locate a factory at Winnipeg, Man.

The National Brake and Electric Company, Milwaukee, Wis., will erect a new machine shop.

Shurly & Dietrich, Galt, Canada, manufacturers of saws and tools, are building an addition.

The Lorraine Motor Company, Philadelphia, Penn., is to build an uptodate garage, to cost $60,000.

The Intercolonial Railway will build shops and roundhouse at Campbellton, N. B., costing $250,000.

The Business Association, of Lisbon, Ohio, announces it has secured a $50,000 automobile factory.

Fred W. Wakefield has plans made to operate the Wakefield Brass Company, at Vermilion, Ohio.

Snead & Co., Jersey City, N. J., manufacturing structural steel, will erect a three-story addition.

Fire destroyed the garage of the Maxwell-Briscoe Company in Albany, N. Y. Loss, about $100,000.

The Overland Automobile Company is constructing an extensive addition to its plant in Toledo, Ohio.

The Storm Lake (Iowa) Auto Company will build the fourth largest garage in the State, it is said.

The Thomas Brass and Iron Company, Waukegan, Ill., is contemplating the erection of a new factory.

The British Columbia Marine Railway Company expect to locate a shipbuilding plant at Esquimault, B. C.

The American Automobile Company, Beatrice, Neb., is having plans prepared for a three-story factory.

The McRae & Roberts Company, Detroit, Mich., manufacturer of steam specialties, will erect a new factory.

Landers, Tracy & Clark, New Britain, Conn., cutlery manufacturers, are preparing to erect a seven-story addition.

The plant of the Syracuse (N. Y.) Malleable Iron Company was damaged by fire to the extent of $30,000.

The Rochester (N. Y.) Machine Tool Works has purchased a building, which will be remodeled for its needs.

The Dalton Adding Machine Company, Poplar Bluff, Mo., has awarded contract for the erection of a building.

The D. R. Dingwall Company is building a new six-story factory at Winnipeg, Man., for manufacturing jewelry.

Work has been begun on the main building of the plant for the Bonner Wrench Company, at Champaign, Ill.

The Otis Elevator Company is having plans prepared for a $50,000 foundry building, to be erected at Harrison, N. J.

The Summer Iron Company has secured 300 acres of land at Vancouver, B. C., and will locate a large plant there.

The Cleveland Bridge and Engineering Company, of Darlington, England, will locate immense new shops at Montreal.

The National Clock and Electric Manufacturing Company, St. Louis, Mo., is considering the erection of a new factory.

The American Diesel Engine Company, 2925 South Broadway, St. Louis, Mo., is planning to erect a $3,000,000 plant.

The George Anderson Company, manufacturers of cranes and stove machinery, will build a new factory at Montreal, Canada.

The New York Central Railroad is inquiring for equipment to cost about $50,000, supplementing list sent out some weeks ago.

The Linderman Machine Company, of Muskegon, Mich., building woodworking machinery, will erect a factory at Woodstock, Ont.

Fire destroyed the agricultural implement plant of the H. P. Deuscher Company, Hamilton, Ohio. Loss, $100,000. Will be rebuilt.

The Mercedes Company, Times building, New York, will erect a plant in Long Island City, for the manufacture of the Mercedes car.

The Superior Drop Forge and Manufacturing Company, Cleveland, Ohio, will build a $4000 addition at 2311 West Seventy-third street.

The Ferro Foundry and Machine Company, Cleveland, Ohio, will erect a new $15,000 factory at Hubbard avenue and East Sixty-sixth street.

The Green Shipbuilding Company, Everett, Mass., is considering locating a plant in the Pacific Northwest, if suitable arrangements can be made.

Building permit has been issued to the Niagara Machine and Tool Company, Buffalo, N. Y., for a four-story factory building to cost $81,000.

The Voelkner & Harry Manufacturing Company, Detroit, Mich., manufacturing hardware specialties, dies, tools, etc., is erecting a new plant.

The machine shops of the Canadian Iron Company, at Londonderry, N. S., which were destroyed by fire, will be rebuilt at once and greatly enlarged.

The Ward Nail Company, Wick building, Youngstown, Ohio, incorporated a short time ago, is said to have secured an option on a site for its plant.

The Fulton Machine and Vise Company, Lowville, N. Y., has increased its capital stock and will enlarge its plant. A new foundry will be built.

The Cleveland (Ohio) Motor Truck Manufacturing Company, recently incorporated, has leased a factory building, but intends putting up its own plant later.

Irwin & Leighton, of Philadelphia, Penn., are estimating on the group of 26 shop buildings for the Pennsylvania Railroad to be built in Northumberland.

It is reported that the Maxwell Automobile Company, of Tarrytown, N. Y., is considering leasing the Crane foundry to operate in connection with its plant there.

The Howse Commercial Car Company, Detroit, Mich., is planning the erection of a plant. This concern was recently formed by Chas. F. Howse and others.

Post Van der Burg & Co., Willemsplein 11-12, Rotterdam, Holland, is in the market for radial drills, upright drills and lathes with one pulley, patent head.

The Gifford-Wood Company, of Hudson, N. Y., and the Arlington Company, of Arlington, Mass., have consolidated and will build a large machine shop at Hudson.

Plans have been prepared for a new factory for the Wallace Barnes Company, Bristol, Conn. The company manufactures wire springs, washers, screw-machine products.

The Columbus (Ohio) Die, Tool and Machine Company is preparing to move into the four-story building on Mt. Vernon avenue, formerly occupied by the Columbus Biscuit Company.

General Manufacturing

Fort William, Ont., will buy an electric locomotive.

The Wadena (Sask.) Flour Company will equip large mills.

Point Grey, B. C., will spend $500,000 for a waterworks system.

The Victoria Mills, Thornton, R. I., will install new machinery.

Farmington, Minn., has voted $10,000 bonds for a waterworks system.

The city of Seaforth, Ont., will install a hydroelectric power plant.

The Narragansett Mills, Fall River, Mass., will build a large addition.

The Puritan Mills, of Fall River, Mass., will increase its equipment.

The Cohannet Silver Company, Taunton, Mass., will erect an addition.

W. S. Frazier & Co., Aurora, Ill., will establish a $40,000 wagon plant.

American Valve Company, Coxsackie, N. Y., is building a new power plant.

The Hickman (Ky.) Wagon Company is planning to increase its output.

The Standard Chemical Company will establish a branch in Winnipeg, Man.

The Salem (N. J.) Electric Company will erect a new modern power plant.

The Enterprise Dye Works, Wconsocket, R. I., will install new machinery.

The Knickerbocker Cement Company is erecting a plant at Hudson, N. Y.

The Minnesota Woodenware Company, Foley, Minn., will rebuild its plant.

A $20,000 boiler house will be erected for the Reading (Penn.) Iron Company.

The Zanesville Art Pottery Company will rebuild its plant in Zanesville, Ohio.

The Velie Carriage Company, Moline, Ill., is planning to install new machinery.

The city of Mulvane, Kan., voted to issue $30,000 bonds for waterworks system.

The American Textile Company, Pawtucket, R. I., will erect a three-story addition.

The Fargo (N. D.) Fibre Twine Company has had plans prepared for a new plant.

W. E. Harvey will establish a cement, block and tile factory at Renwick, Iowa.

The Desmond-Flint Glass Company, Montreal, Canada, is build a $20,000 addition.

The Union Glass Company, Texarkana, Tex., recently formed, will erect a plant.

The Frank C. Schilling Company, Green Bay, Wis., will erect a cold-storage plant.

Birmingham (Ala.) Horseshoe and Rolling Mills Company will erect a power house.

The Bradshaw Brick and Tile Company, Fort Dodge, Iowa, will erect a new plant.

The city council, Rushford, Minn., will make extensions to its electric-light system.

Rush City, Minn., will vote on the question of issuing bonds for a waterworks system.

The Wyandotte Worsted Company, Waterville, Me., will erect a one-story addition.

Plans have been drawn for a large addition to the Stevens Linen Works, Dudley, Mass.

The city of Timmonsville, Okla., will vote on issuance of $30,000 bonds for waterworks.

J. S. Collins & Son, Mooreston, N. J., will increase the capacity of their power plant.

The Buller Gloria Mills, Norwalk, Conn., will build an addition to be used as a lace mill.

Calgary, Alberta, will spend $125,000 for an addition to its power house and new equipment.

The Dartmouth Mills, New Bedford, Mass., will build an addition to be used as a cloth room.

The Hazel-Atlas Glass Company, Washington, Penn., is trying to find site for a new plant.

The New York State Training School for Girls, Hudson, N. Y., is erecting a new power plant.

F. E. Perry, Mill street, Gardner, Mass., is receiving propositions for waterwheel governor.

The F. W. Hanpeter Furniture Company, St. Louis, Mo., is building a four-story addition.

Fire destroyed the refrigerating plant of Swift & Co., Troy, N. Y., causing $40,000 damage.

The plant of the St. Louis (Mo.) Axle Company was destroyed by fire. Loss, $30,000.

The Larkin Soap Company, Peoria, Ill., will erect an eight-story addition to cost $150,000.

The Argillo Works, Carbon Cliff, Ill., tile manufacturers, is erecting a number of new buildings.

The Central Iowa Produce Company, Atlantic, Iowa, will install a cold-storage and ice plant.

The buildings of the Globe Grain Elevator Company, Buffalo, N. Y., were burned. Loss, $125,000.

The new Foster building, in course of erection at Denver, Colo., will have its own heating plant.

Contracts will be awarded for new boilers for the municipal electric-light plant at Redfield, S. D.

The Globe Pottery Company, East Liverpool, Ohio, will increase the capacity of its clay shops.

The Huebner Brewing Company, Toledo, Ohio, has taken out a permit for an addition to its plant.

The La-Fortune Optical Company, of Haverhill, Mass., is looking for a site in Southbridge, Mass.

The New Richmond (Wis.) Roller Mills Company will install an auxiliary steam power plant.

The Standard Sanitary Manufacturing Company, Toronto, Ont., is building a new power house.

The citizens of Morristown, S. D., will vote on the issuance of $10,000 bonds for waterworks system.

Fire destroyed the plant of the May Lumber Company, North Side, Pittsburg, Penn. Loss, $75,000.

Outlook, Sask., will equip a large new power house in connection with its water-supply system.

The Nasmith Bakery Company, Toronto, Ont., will expend $60,000 in equipping a branch factory.

The Superior Clay Works, Fort Dodge, Iowa, will increase its capital stock and enlarge its plant.

The Hutchinson Fibre Box Company, Muskegon, Mich., will locate a branch plant at Woodstock, Ont.

The Consumers Power Company will spend $30,000 for improvements to its gas plant at Faribault, Minn.

The Kahn Trussed Concrete Steel Company, Youngstown, Ohio, is erecting an addition to its plant.

The Chipman-Holton Knitting Company, of Hamilton, Ont., will locate a branch factory in Welland, Ont.

The Van De Carr Paper Company, of Stockport Center, N. Y., is rebuilding and enlarging its plant.

The Leader Weaving Company, of Central Falls, R. I., will equip its plant with motor-driven machinery.

The Salem (N. J.) Glass Company will increase the capacity of its power plant. Will install new boiler.

The O'Donnell Shoe Company, St. Paul, Minn., will erect a six-story factory at Tenth and Sibley streets.

The Du Pont Powder Company is rebuilding its mill, recently wrecked by explosion at Schaghticoke, N. Y.

H. J. Heinz Company, Salem, N. J., is erecting an addition, also increasing the capacity of its power plant.

The Des Moines (Iowa) Silo Manufacturing Company will build an addition, doubling its present capacity.

The Quinebaug Company, Danielson, Conn., will install two new steam engines of 300 and 500 horsepower.

The Young Men's Christian Association, Lawrence, Mass., will install a horizontal-tubular steam boiler.

The plant of the American Clay Products Company, Stillwater, Minn., was destroyed by fire. Will be rebuilt.

The Dennison Tag Company, of South Framingham, Mass., will establish a branch in Southbridge, Mass.

The city of Fairmont, Minn., will issue $30,000 bonds for improving its electric-light plant and waterworks.

A large transformer substation, in connection with the Niagara Power line, will be erected at London, Ont.

W. M. McMorris & Co., Portland, Ore., harness makers, have had plans drawn for a new three-story factory.

The Monarch Manufacturing Company, Toledo, Ohio, manufacturing lubricating oils, is erecting a new plant.

Fire destroyed the dyeing establishment of James W. Masland & Co., and I. Brophy's Sons, Philadelphia, Penn.

The Stanley Works, New Britain, Conn., will soon install a new 500-horsepower steam turbine and generator set.

The Cleveland (Ohio) Electric Illuminating Company has secured a permit for the erection of a new power house.

Plans have been completed for a new power house for the Mt. Vernon Railway and Light Company, at Columbus, Ohio.

The cooper shop of G. Gossett & Son, Jamestown, N. Y., was almost totally destroyed by fire. Loss, $15,000.

N. B. Twogood, of Emmetsburg, Iowa, is planning for the establishment of a cement tile factory at Pilo Mound, Ia.

The city of Floresville, Tex., will install an engine and air compressor in its waterworks plant. Address the mayor.

The Hammonton & Egg Harbor City Gas Company, Hammonton, N. J., will increase the capacity of its power plant.

The Scott Manufacturing Company will establish a plant at Des Moines, Iowa, for manufacturing bath-room heaters.

The Cumberland Glass Company, Bridgeton, N. J., is to increase the capacity of its power plant. Will install new boiler, etc.

Pathe Freres, of New York, manufacturers of moving-picture films, are to erect a factory in Jersey City, N. J., to cost $60,000.

The Crystal Ice Manufacturing Company, Argenta, Ark., will double the capacity of its plant. About $50,000 will be expended.

The Gold Issue Mill, of the Bonanza-Midget Gold Mining Company, Cripple Creek, Colo., was burned. Loss, about $200,000.

The plant of the Dominion Explosives Company, at Arnprior, Ont., wrecked by an explosion, will be rebuilt on a larger scale.

The Ohio Valley Scenic Route Company, of Toronto, Ohio, has purchased a building, which will be converted into a power house.

The Dowswell Manufacturing Company, Hamilton, Ont., making washing machines, etc., will build large extensions to its plant.

The Booth Demountable Rim Company, Cleveland, Ohio, has increased its capital stock and will install additional machinery.

An addition is being erected to the power house of the Toledo (Ohio) Railway and Light Company at the foot of Madison street.

The Pittsburg Cut Glass Company, Pittsburg, Penn., will add twelve frames to its capacity. New grinding wheels will be bought.

The sawmills of the Fort Frances Lumber Company, at Fort Frances, Canada, were destroyed by fire. Loss, $60,000. Will be rebuilt.

It is reported that Whitney Bros., of Superior, Wis., are contemplating establishing a branch cement and brick plant at Duluth, Minn.

The Laclede Power Company, St. Louis, Mo., has applied for a permit to erect a $25,000 power house at the foot of Mound street.

The Panola Cotton Mill, Greenwood, S. C., has plans ready for its plant. The company was organized a short time ago with $30,000 capital.

The Citizens Light, Heat and Power Company, Montgomery, Ala., will spend $500,000 on new equipment for its plant, doubling its capacity.

Edwin Bennett Pottery Company, Baltimore, Md., is ready to buy machinery for a new six-kiln plant, outside of presses and agitators.

The National Fireproofing Company, of Pittsburg, Penn., will erect a plant in Elkton, Md., for the manufacture of terra cotta hollow tile.

C. W. Dean & Co., Cochituate, Mass., shoe manufacturer, is having plans drawn for a five-story factory for which it is seeking suitable location.

The Syndicate Holding Company, Minneapolis, Minn., will erect a plant for dry cleaning and laundry at Second avenue and Thirteenth street.

The city of Warrenton, Ohio, voted $25,000 bond issue for water and sewer system. Fuller-Coult Company, Chemical building, St. Louis, engineers.

The Joseph W. Benn Company, of Greystone, R. I., manufacturing alpacas and mohairs, is making improvements to its plant to the extent of $500,000.

The Oxford Linen Mattress Company, an auxiliary of the Oxford Linen Mills Company, of North Brookfield, Mass., will erect a plant at Winona, Minn.

The Diamond State Fiber Company, Bridgeport, Penn., is in the market for coal-handling machinery. F. W. Dean, 53 State street, Boston, Mass., is engineer.

The city council, Clinton, Iowa, has passed a resolution instructing the city engineer to prepare estimate of the cost of installing a modern municipal water plant.

F. A. Holden, of Philadelphia, will be the head of a firm to be known as the Woodstock Textile Company, which will build a large factory in Woodstock, Canada.

The Morgan Construction Company, Worcester, Mass., has plans and specifications ready for a new foundry and office building to be erected in Greendale, Mass.

Prosper Colony Manufacturing Company, Taft, Fla., recently incorporated, will establish a plant to manufacture boxes, crates, etc. Nicholas Dennis is president.

Fire wrecked the plant of the Southern Veneering Manufacturing Company, Louisville, Ky., causing a loss of about $50,000. Main building and drying house were destroyed.

The Sterling-Moline Traction Company has awarded contract for the construction of a road. Power plant will be erected at Lyndon, Ill. The offices of the company are at Sterling, Ill.

The American Concrete and Street Railroad Company, with offices in the Central National Bank Building, St. Louis, Mo., will erect a plant for the manufacture of concrete railroad ties.

Fire destroyed the plants of Truslow & Fuller, cork manufacturers, Regal Sack Company, Independent Baking Powder Company, W. Ames & Co., manufacturer of spikes, all in Jersey City, N. J.

The Rockwood Sprinkler Company, Worcester, Mass., manufacturing automatic fire sprinklers, will move into a larger factory and double its output. $100,000 worth of new machinery will be installed.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., September 8, for oxyacetylene welding and cutting plant, cold-rolled steel, bronze, drift bolts, screws, valves, chain blocks, grindstones, saws, vises, reamers, etc., as per Circular No. 601.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids Aug. 30, as follows: 1500 pounds lubricating graphite (schedule 2817), turbo-generating set (schedule 2815), 2050 pounds sheet brass, 14,300 pounds bar steel (schedule 2816), 78,200 pounds steel castings, 9000 pounds steel forgings, 64,600 pounds and 50,000 pounds forged steel, 13,900 pounds and 28,675 pounds high-speed tool steel (schedule 2810), 77,500 pounds rivet steel, galvanized sheet steel (schedule 2812); September 13—Twelve blacksmith's anvils, 36 gasolene torches, hand tools (schedule 2821).

New Incorporations

Roll Edge Machine Company, Cleveland, Ohio. Manufacture hat machinery. Incorporators, Geo. P. Carney, Geo. L. Carney, F. M. Walke, etc.

Stearns & Waterman Company, Boston, Mass. Manufacture and deal in heating apparatus. Capital, $50,000. T. L. Waterman, Woburn, president.

Chandler Shoe Company, Vineland, N. J. Manufacture shoe machinery. Capital, $100,000. Incorporators, D. Harry Chandler, H. H. Chandler, Geo. W. Chandler.

Motor Engineering Company, Chicago, Ill. Manufacture machinery. Capital, $10,000. Incorporators, Harvey L. Hanson, Leonard W. Novander, Arthur H. Boettcher.

Edwards-Crist Manufacturing Company, Chicago, Ill. Manufacture motorcycles. Capital, $30,000. Incorporators, Jesse Edwards, Robert C. Crist, A. O. Lambeau.

The Doctor Walker Company, Dayton, Ohio. Manufacture surgical instruments. Capital, $150,000. Incorporators, Dr. C. A. Walker, H. G. Ardleigh, A. H. Vayo, etc.

Lake Erie Machinery Company, Buffalo, N. Y. Manufacture machinery, etc. Capital, $15,000. Incorporators, Frank B. Schuster, Charles Stauffer, Judson S. Rumsey.

Wertz Lumber Company, Canal Dover, Ohio. Manufacture lumber and building materials. Capital, $35,000. Incorporators, V. F. Pretorius, F. E. Wible, Fred Wertz, etc.

Atlas Interlocking Stair Company, New York. Manufacture and deal in structural iron and steel work. Capital, $30,000. Incorporators, M. E. Gates, Jr., H. Caplan, P. Curtis.

Motor Car Company of America, New York. Manufacture motors, engines, motor cars, motorboats, etc. Capital, $100,000. Incorporators, C. L. Holden, C. L. Scofield, J. H. Hershfield.

Langeran Manufacturing Company, Cleveland, Ohio. Manufacture hardware, steel articles, machines and tools. Capital, $250,000. Incorporators, W. C. Langeran, J. F. Langeran, etc.

Auto Steam Vulcanizer Company, Cincinnati, Ohio. Manufacture steam vulcanizer for automobile tires. Capital, $10,000. In-

corporators, D. T. Detrich, W. P. Hammer, J. E. Hitch, etc.

The Hanna Locomotive Stoker Company, Cincinnati, Ohio. Manufacture stokers for locomotives, steam boats, etc. Capital, $500,000. Incorporators, W. F. Hanna, C. Stannes, T. W. Nieder, etc.

Swartwout Manufacturing Company, Kirkland, N. Y. Manufacture and deal in hand trucks, carts, motorcycles, bicycles, etc. Capital, $25,000. Incorporators, A. E. Swartwout, M. B. Swartwout, E. B. Stanley.

Aero Vehicle Company, Atlantic City, N. J. Manufacture and deal in vehicles for aërial transportation. Capital, $125,000. Incorporators, Jas. R. Greig, S. C. Fenner, of Philadelphia; Eli H. Chandler, Atlantic City.

Mockridge Condenser Company, Newark, N. J. Manufacture condensers, machinery, etc. Capital, $100,000. Incorporators, O. N. Mockridge, Belleville, N. J.; A. W. Mockridge, Jersey City; N. D. Gibley, Newark.

Lovelace Aeroplane and Motor Company, New York. Manufacture and sell motors, engines, self-propelling vehicles, etc. Capital, $25,000. Incorporators, Henry Amerman, 2 Rector street, Francis W. Marshall, 155 West Fifty-eighth street, New York, etc.

Business Items

"Mine and Quarry," published by the advertising department of the Sullivan Machinery Company, Chicago, Ill., enters its fifth volume with the issue of July, 1910. This is a quarterly bulletin of news for superintendents, managers, engineers and contractors, and is attractively illustrated.

Wells Brothers Company, Greenfield, Mass., is sending the foremen of the various departments of its factory, and their families, on outings during the summer months. These outings take the form of all-day automobile trips through the surrounding countryside, and to the nearby cities and towns. One or two of the foremen, with their families, are sent at each time, the company providing a touring car and paying all expenses. Each trip is about 125 miles long, the start being made early in the morning and the return ride early in the evening. Dinner is arranged for at one of the hotels at the point of destination. These trips are all to different places and all have proved very enjoyable to the heads of departments and to their families.

Trade Catalogs

Bonney Vise and Tool Works, Allentown, Penn. Catalog No. 15. Drop-forged wrenches. Illustrated, 24 pages, 3½x6 inches, paper.

Reeves Pulley Company, Columbus, Ind. Catalog No. 22. Reeves wood-split pulley. Illustrated, 32 pages, 3x5½ inches, paper.

The Advance Machinery Company, Toledo, Ohio. Catalog. Advance-Wetmore glue heaters. Illustrated, 64 pages, 6x9 inches, paper.

H. H. Franklin Manufacturing Company, Syracuse, N. Y. Catalog. Franklin die-cast finished parts. Illustrated, 20 pages, 6½x9 inches, paper.

Link-Belt Company, Philadelphia, Penn. Catalog No. 90. Conveyers, carriers, clutches, buckets, chains, etc. Illustrated, 400 pages, 6x9 inches, cloth.

Walter Macleod & Co., East Pearl street, Cincinnati, Ohio. Book No. 9. Buckeye melting furnaces, heaters, torches, sand blasts. Illustrated, 16 pages, 7½x10½ inches,

Forthcoming Meetings

National Society for Promotion of Industrial Education, fourth annual convention, Boston, Mass., November 17, 18 and 19.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. S. Clark, secretary, 141 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Philip Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

WANTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E.G.Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, Amer. Machinist.

Wanted—Work for screw machines and gear cutter. Box 775, American Machinist.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Draftsmen—Get a copy of "Dimensions of Pipe, Fittings and Valves," 75c. National Book Co., Collinwood, Ohio.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Patents. C. L. Parker, Patent Attorney, ex-examiner Patent Office, 990 G St., Washington, D. C. Write for Inventor's Handbook.

American engineer wants to correspond with British manufacturers of pipe fittings; of unusual interest. Box 883, Amer. Mach.

New ideas developed, designing and detailing of special machinery; terms reasonable and work strictly confidential. Box 798, American Machinist.

Machinist or mechanical engineer, capable of handling manufacturing end of prominent, successful manufacturing business, desired as partner; must invest. Box 889, Am. Mach.

A well equipped machine shop within 30 miles from New York solicits orders for all kinds of machine work. Send inquiries: The Brunswick Refrigerating Co., New Brunswick, N. J.

Light or medium weight machinery to manufacture on contract or special machinery to build. Box 734, American Machinist.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, American Machinist.

Any broken machinery parts expertly welded by oxy-acetylene process; difficult repairs requiring skilful preheating are our specialty; automobile cylinders and crank cases also; ask for detailed information, references, etc.; we positively weld (not braze) cast iron, aluminum and other metals; no charge unless successful; one trial will convince you. Waterbury Welding Works, Waterbury, Conn.

Factory Wanted—A foreign concern desires to secure a factory somewhere between Philadelphia and Providence, and within an hour's journey from Philadelphia, New York or Boston; a factory of from 6000 to 12,000 square feet is required; preferably all on the ground floor, but 6000 square feet must be ground floor; the right place will be taken on a short lease with option to buy, or will be bought outright. Box 891, Amer. Mach.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CALIFORNIA

Wanted — Bookkeeper for manufacturing plant, employing from 20 to 25 hands; young man familiar with modern uptodate methods, cost keeping, etc. Write fully age, experience, salary wanted. Box 812, Amer. Machinist

CANADA

Wanted — First-class man on automatic screw machine work, setting up, camming, devising new tools and methods speeding up; highest wages to the right man. Box 825, American Machinist.

COLORADO

Due to the steady increase of our business, we are constantly in need of drill press, lathe, planer, grinder, Jones & Lamson and bench men; also toolmakers and tool smiths; good climate and location; steady work, good pay to first-class men; shop clean, light and well ventilated; 9 hours work. Address, stating experience. J. Geo. Leyner Engineering Works Co., Littleton, Colo.

CONNECTICUT

Wanted—Salesmen to handle on a generous commission basis, a well advertised and quick selling line of lathe tools; commissions given on all orders received from prescribed territory; send references with reply. Address "R. T.," American Machinist.

ILLINOIS

Wanted—By a specialty manufacturing concern in Chicago, a man capable of taking charge of assembling department; must be active, energetic, systematic, and possessed of some mechanical ingenuity, and capable of handling help, both male and female; state age, past experience in full, present occupation and wages desired in first letter to receive consideration. Box 867, Amer. Mach.

INDIANA

Wanted—A-1 man for tempering tools; one who has experience in case-hardening preferred; give experience and references. Address "A. B. C.," Box 186, Indianapolis, Ind.

Wanted—A thoroughly capable foreman for tool room employing twenty toolmakers and machinists; must be naturally endowed with capacity to command respect of workmen and be thoroughly experienced in very accurate and exacting punch and die work. Address "A. B. C.," Box 186, Indianapolis, Indiana.

MASSACHUSETTS

Wanted—Experienced and designing draftsmen. Address replies to Supervisor of Drafting Rooms, General Electric Co., Pittsfield, Mass.

Wanted — An experienced pattern shop clerk, one who is capable of looking after detail pattern shop and time records; answer, stating age, experience and salary expected. "Confidential," Box 877, Amer. Machinist.

Wanted—Machine and tool designer accustomed to work on special and automatic machinery for small parts; permanent and growing position for right man. Box 871, American Machinist.

Wanted—High-class experienced mechanic to take charge of estimating department from

drawings; one familiar with speed of machinery, piece work and time study methods. Box 888, AMERICAN MACHINIST.

Wanted—An experienced stock ledger man, one who has had considerable accounting experience and capable of taking entire charge of stock ledgers under the direction of the general storekeeper; state age, experience and salary expected. "Opportunity," Box 878, AMERICAN MACHINIST.

MICHIGAN

Toolmakers; married men preferred; only first-class men need apply; steady work and good wages for right parties. Box 872, AM. M.

Salesman for stamping line; first-class man, acquainted with general trade in heavy metal; state experience, references, volume of business, salary, etc. Detroit Pressed Steel Co., Detroit, Mich.

NEW JERSEY

Lathe and vise hands in shop, 15 miles from New York; must be sober and steady; opportunity for advancement; state experience, references, wages and all information in first letter. Box 843, AMER. MACHINIST.

NEW YORK

Cost accountant for public accountant's office; must understand thoroughly iron, brass and steel foundry costs; state qualifications and salary expected. Box 870, AMER. MACH.

Wanted—First-class lathe hands, planer hands, boring mill and slotter hands; also a few erectors; must be first class and accustomed to heavy work. Address P. O. Box 953, Buffalo, N. Y.

Wanted—Experienced draftsman with experience in furnaces, structural steel, piping, etc.; small town in western New York; give full particulars and state salary required. Box 826, AMERICAN MACHINIST.

Wanted—Four or five first-class all-around machinists and two good patternmakers; give full details of past experience, where now employed, reference and age; good wages and permanent employment to good men. Box 881, AMERICAN MACHINIST.

Wanted—An assistant to superintendent; must be first-class all-around machinist, young, ambitious, anxious and eager to assume responsibilities; state kind of machinery most familiar with, whether previously experienced handling men, salary expected, age, etc. Box 890, AMERICAN MACHINIST.

OHIO

Wanted—General machine shop foreman, capable of managing the machine department of an electrical plant, manufacturing small motors and dynamos; applicant must be A-1 in handling men and equipment; state age, experience and salary. Box 845, AM. MACH.

Wanted—Superintendent in Cincinnati, experienced in building lathes and radial drills; applicant must show good past record and must be capable of assuming entire charge of the manufacturing end of our business. Box 862, AMERICAN MACHINIST.

Wanted—First-class machinists, toolmakers die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Wanted—Floor hands and fitters on machine tool work. Colburn Machine Tool Co., Franklin, Penn.

Machinists—Machine operators wanted for day and night turn; plenty of work; none but sober and steady men need apply. Standard Engineering Co., Ellwood City, Penn.

Wanted—A man capable of originating and mechanically developing new and novel articles of hardware for household, store or farm use; state past experience and accomplishments, also salary expected. Box 876, AMERICAN MACHINIST.

The Monotype School is maintained to train young men to meet the constant demand for operators of our type casting and composing machine; these operators do so well that we receive more applications for places than can be filled; these qualifications carry most weight: Common sense, automatic machinery experience, printing office experience, type foundry experience. Full particulars will be furnished to inquirers who furnish the same information about themselves, and mention this paper. Lanston Monotype Machine Co., Philadelphia.

RHODE ISLAND

Wanted—Salesman on hoisting engines; must be acquainted with the trade; opportunity of a life time for the right man; applications will be received until September 1. Box 850, AMERICAN MACHINIST.

Wanted—Superintendent for shop on medium heavy engine work; splendid opportunity for the right man; must be uptodate and able to modernize in the best sense of the word; no system crank need apply; applications received until September 1. Box 849, AM. MA.

TENNESSEE

Wanted—First-class machine tool repair man, regular toolmaker who can handle repairs preferred; give experience and reference; permanent position to right man. Address Southern Engine & Boiler Works, Jackson, Tenn.

SITUATIONS WANTED

Classification indicates present address of advertiser, nothing else.

DELAWARE

Wanted—Position as superintendent by man of 36; 15 years' experience in manufacture of special and automatic machinery, gasolene engines and accessories; thorough mechanic, familiar with modern methods, office work, cost systems and estimating; able to produce results at minimum costs; present salary $1500. Box 886, AMERICAN MACHINIST.

ILLINOIS

Situation Wanted—Mechanical superintendent and shop systematizer; splendid record as a producer on light and medium weight machinery; experienced as chief draftsman, master mechanic and production engineer; familiar with gas engines and automobile parts; now employed by a large house making metal specialties as general superintendent; experience with building and starting new factories. "Designer," 3264 Fulton St., Chicago.

MASSACHUSETTS

Special machine designer wishes to change. Box 864, AMERICAN MACHINIST.

Draftsman with good experience on tool and jig designing would like position. Box 868, AMERICAN MACHINIST.

Superintendent, shop and foundry, general and duplicate work; good mechanic, executive, aggressive; successful with men. Box 847, AMERICAN MACHINIST.

Wanted—Position as foreman of screw machine department; expert on estimating speeds and feed, and best method of production. Box 863, AMERICAN MACHINIST.

Superintendent of a large manufacturing plant, with wide experience on automatic and labor saving devices, desires making a change. Box 788, AMERICAN MACHINIST.

Superintendent, 36, desires change; 15 years' experience in light and medium manufacturing by uptodate methods; best references. Box 874, AMERICAN MACHINIST.

Man with technical training, experience as chief draftsman, systematizing shop work, assistant superintendent, installation of premium system, wants position of assistant superintendent or installing premium system. Box 879, AMERICAN MACHINIST.

MISSOURI

Position as general foreman; now employed; 15 years' experience on small and medium interchangeable parts; thoroughly up to date on dies, jigs and manufacturing facilities; A-1 hustler and good executive ability. Box 852, AMERICAN MACHINIST.

NEW JERSEY

Young man, long experience, machinery, mechanical products, good salesman, desires position; also as manager, purchasing agent or executive. Box 887, AMER. MACHINIST.

Engineer would like to correspond with parties requiring superintendent or designer; have many years' experience; at present engaged; technical. Box 884, AMER. MACH.

NEW YORK

Plant order clerk, a hustler, experienced and energetic; can furnish references. Box 869, AMERICAN MACHINIST.

Mechanical engineer, 10 years' experience, open for engagement. Box 855, AMER. MACH.

Mechanical engineer, 18 years' experience in tool and dies, and well familiar in die castings. Box 856, AMERICAN MACHINIST.

First-class tool designer, with years of practical experience, is open for position September 1, 1910. Box 866, AMER. MACH.

As superintendent of machine shop and foundry, steam pumps, etc.; up to date; practical in all departments. Box 873, AM. MA.

Foreman, middle aged, now employed, latest methods, engineering, dynamos, electrical and general machinery; A-1 hustler; can handle force with executive ability. Box 860, AM. M.

First-class mechanic, experienced in building, repairing and driving automobiles, graduated from German technicum, speaking six languages, 32 years of age, wants a steady position as a draftsman, demonstrator or foreman in an automobile factory. Box 880, AMERICAN MACHINIST.

Superintendent or factory manager, open for first-class connection with reliable concern; am thoroughly experienced in the manufacture of small and medium size interchangeable machines and office appliances; understand the application of modern methods to the management and organization of a factory; highest references. Box 875, AM. M.

OHIO

Working tool foreman, 11 years' experience with leading manufacturer of brass goods, desires change; references furnished on request. Box 865, AMERICAN MACHINIST.

Works manager or general manager, by man of wide shop and office experience in manufacturing, with first class firms; have god control of men and have had full charge of manufacturing in two large plants in last 14 years; will be available September 1; special experience in drafting room, pattern shop, foundry, brass, steel and iron, machine shop, boiler shop and structural shops; can give high class references. C. B. A., AMER. MACH.

PENNSYLVANIA

Tool draftsman and designer with shop experience, desires to change; Philadelphia or vicinity. Box 882, AMERICAN MACHINIST.

Designer of special tools, jigs, fixtures and special machines, with shop experience, desires a position; Philadelphia or vicinity. Box 885, AMERICAN MACHINIST.

WISCONSIN

Situation wanted with company entering manufacture of automobiles or motors; capable of purchasing and installing machinery and tools, designing tools, jigs and fixtures, and as tool-room foreman; over ten years' practical experience; similar positions held before; at liberty October 1. Box 832, AM. M.

FOR SALE

For Sale—Nearly new No. 16 oven furnace. Mr. Wales, Keene, N. H.

For Sale—One Rarefied dust collector, new; never been used; will make price right. The Ready Tool Co., Bridgeport, Conn.

For Sale—Electric welder Toledo No. 3, with spot welding jaws; new February, this year; capacity ¾ inch; thoroughly overhauled. F. H. Brown, 103 Chandler Ave., Detroit, Mich.

Four thousand dollars will buy a light manufacturing machine shop, brass foundry and plating works, doing a safe, steady, profitable business in this city; established twenty years; health only reason for selling. For full information address Hoyt Investment Company, 4290 Queen Ave., South, Minneapolis, Minn.

For Sale—Three return tubular boilers, manufactured by Riter Bros., Buffalo, N. Y. Drums 72x16 feet 0 inches; each boiler with sixty-six 4-inch tubes; inspected by Travelers Indemnity Company, of Hartford, Conn; 93 lb. steam pressure; boilers in good condition; can be delivered in two to three months, and seen in operation at Buffalo Bolt Company's plant, North Tonawanda, N. Y.

For Sale—One No. 4 Le Blond milling machine, practically new, including extra attachments and cutters; cost over $1800 complete, will sacrifice; also will sacrifice one No. 6 Foster screw machine; also will sacrifice one 2-cylinder, 25-horsepower International Harvester gasolene engine, extra attachment for gas included. Ann Arbor Marine Engine Mfg. Co., Ann Arbor, Mich.

An opportunity to start a machine shop; we offer one of our departments for sale, the one used to establish our business; it is small and profitable work, but as we are devoting ourselves to heavier work, we offer to sell for $2000, all the drawings, patterns, and stock of finished and partly finished parts and rough material (inventories over $3000), circulars, electrotypes, special machinery and fixtures, and an established trade. Address Sipp Machine Company, Paterson, N. J.

For Sale—One Nash gas engine, 20 horsepower, two cylinder, for electric lighting, pumping or power; one Beaman & Smith horizontal boring mill; table 25 inches wide, 36 inches long; will bore 12 inches diameter, 24 inches long, and face 20 inches diameter; one 300 light J. B. Colt Co. acetylene gas apparatus. The above machines are in excellent condition, having been very little used. For further particulars and prices apply to Rider-Ericsson Engine Co., 35 Warren St., New York.

For Sale—Machine shop, foundry, boiler, blacksmith and pattern shop and general machinery supply business; complete equipment and doing a profitable business; located in the greatest coal, metal mining and smelting, timber and farming section of Colorado; fine city, climate, water and schools; unusual opportunity for machinist and foundryman to form partnership and secure prosperous growing business, at a sacrifice; family death necessitates owner leaving. Box 800, AM. M.

Talks With Our Readers

By the Sales Manager

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION—that's the sub-heading of the AMERICAN MACHINIST.

Yet some of our friends persist in calling it "a machine tool paper."

They might as well call the core of an apple the whole apple.

Machine construction—not machine tool—the machines and methods used in building machinery of every kind.

* * *

The AMERICAN MACHINIST covers all that enters into machine construction from the drafting room to the paint shop.

Look at this issue. There are articles on doing all sorts of machine work from pickling castings to screw machine work.

Of course, you are not interested in all of these.

We don't have to read the AMERICAN MACHINIST all through, word for word, to get our money's worth.

We buy a newspaper, look over the headings, read what interests us and throw it away. We do this to keep ourselves informed as to what is going on in the world.

We don't suffer a sense of loss, a feeling of inadequate return, if we do not read the paper through from date line to the last advertisement; if we are not interested in everything in it.

Is it not as important that we should be informed upon the happenings and developments in our own business as upon affairs in general?

* * *

You have noticed that the appearance of the AMERICAN MACHINIST has changed recently oftener than the styles in our wives' hats.

Our aim has been to make it easier to find what you want, and easier to read it when found.

We want the busy man to see quickly what we have observed and recorded from week to week.

He can then read what he likes, save what he wants to, and throw the rest away.

It costs less than eight cents a week, anyway.

And we are trying to give you the very best engineering paper published for any money.

Of course, a large part of the advertising carried is of machine tools.

That's because machine tools are the means by which all other machinery is constructed.

* * *

But here's a point:

Did you ever realize that machine tools are the only machines that can reproduce themselves?

All the textile machinery, printing presses, locomotives, or automobiles couldn't make another of their kind in a thousand years; but a lathe, a planer, a drilling machine can come pretty near making all the kinds of machine tools in use, and all the rest of the machinery in the bargain.

That's why the AMERICAN MACHINIST carries the advertising of the representative concerns in the machine-tool business—

Why it pays any machine maker to look carefully over the Selling Section.

There's many an idea there, many a helpful suggestion that that will help you make a better showing, save money here, increase production there.

* * *

Say you saw it in the American Machinist.

ALPHABETICAL INDEX TO ADVERTISERS

PAGE

Abbott Ball Co. 90
Acme Machine Tool Co. 36
Acme Machinery Co. 114
Adams Co. 105
Adt & Son, John 89
Albro-Clem Elevator Co. 106
Allen & Co., Ltd., Edgar 97
Almond Mfg. Co., T. R. 92
American Emery Wheel Wks. .. 86
American Gas Furnace Co. 119
American Pulley Co. 89
American Spiral Pipe Wks. ... 124
American Swiss File & Tool Co. 96
American Tap & Die Co. 89
American Tool & Machine Co. 114
American Tool Works Co. 8
American Tube and Stamping Co. 131
American Vanadium Co. 118
American Watch Tool Co. 108
Ames & Co., B. C. 108
Arguto Oilless Bearing Co., 1st cover
Armstrong-Blum Mfg. Co. 110
Armstrong Bros. Tool Co. 97
Armstrong College 125
Auburn Ball Bearing Co. 90
Aurora Tool Works 125
Automatic Machine Co. 83

Baker Bros. 89
Bardons & Oliver 125
Barnes Co., W. F. & John 14
Barnes Co., Wallace 113
Barnes Drill Co., Inc. 85
Barnett Co., G. & H. 66
Bath Grinder Co. 81
Baush Machine Tool Co. 24
Bay State Stamping Co. 125
Bay State Tap & Die Co. 103
Beaman & Smith ....25 and 92
Becker Milling Machine Co., 23 and 120
Bemis & Call Hardware and Tool Co. 116
Besly & Co., Chas. H. 45
Betts Machine Co. 9
Bignall & Keeler Mfg. Co. 110
Bilgram Machine Wks. 104
Billings & Spencer Co. 98
Blaisdell Mchy. Co. .116 and 124
Blake & Johnson Co. 87
Blanchard Machine Co. 114
Bliss Co., E. W. 23
Bliss Mfg. Co., E. C. 107
Blount Co., J. G. 86
Boker & Co., Hermann, Boker & Co., Hermann. .48 and 75
Boston Gear Works 104
Bradford Machine Tool Co. ... 5
Bradley & Son, C. C. 112
Bretz Co., J. S. 123
Bridgeport Metal Treating Co. 122
Bristol Co. ..... 4th cover
Brosnihan Wrench Co. 131
Brown & Co., R. H. 93
Brown & Sharpe Mfg. Co. .... 71 and 4th cover
Brown Hoisting Machry. Co. . 88
Brubaker & Bros., W. L. 110
Bryant Chucking Grinder Co. . 30
Buckeye Engine Co. 110
Buffalo Fdry. & Mach. Co. 112
Bullard Machine Tool Co., 132 and 133
Burke Electric Co. 102
Bury Compressor Co. 116
Butterfield & Co. 113

Caldwell & Son Co., H. W. 90
Carborundum Co. 38
Card Mfg. Co., S. W. 35
Carpenter-Kerlin Gear & Machine Co. 105
Carpenter Tap & Die Co., J. M. 111
Carter & Hakes Machine Co. .. 94
Celfor Tool Co. 114
Century Electric Co. 102
Chambersburg Engineering Co. 110
Champion Tool Works Co. 109
Chicago Flexible Shaft Co. 118
Cincinnati Bickford Tool Co., 10 and 11
Cincinnati Gear Co. 104
Cincinnati Gear Cutting Machine Co. 50
Cincinnati Lathe & Tool Co. ... 108
Cincinnati Milling Mach. Co., 6 and 7
Cincinnati Planer Co. 37
Cincinnati Shaper Co. 50
Clayton Air Compressor Wks. 116
Cleveland Auto. Mach. Co. 18
Cleveland Planer Works 98
Cleveland Twist Drill Co., 4th cover
Clough, R. M. 106
Clum & Atkinson 124
Coates Clipper Mfg. Co. 128
Coes Wrench Co. 31

PAGE

Colonial Leather Co. 106
Colonial Steel Co. 124
Consolidated Press and Tool Co. 112
Cook Co., Asa S. 110
Crane Puller Co. 90
Crescent Forgings Co. 85
Cullen & Atkinson Co., Inc. .. 123
Curtis & Curtis Co. 125
Cushman Chuck Co. 94
Cushman Electric Co. 103

Dallett Co., Thos. H. 117
Dart Mfg. Co., E. M. 115
Davis-Bournonville Co. 123
Davis Machine Co., W. P. 45
Detrick & Harvey Mach. Co. . 102
Diamond Chain & Mfg. Co. 129
Diamond Machine Co. 46
Diamond Saw & Stamping Wks. 128
Dickinson, Thos. L. 66
Dill Slotter People 91
Disston & Son, Henry 48
Dixon Crucible Co., Jos. 122
Doehler Die Casting Co. 121
Dorman, John H. 116
Dreses Machine Tool Co. 22

Earle Gear & Mach. Co. 105
Eastern Machinery Co. 90
Electric Welding Products Co. 124
Electro Dynamic Co. 102
Elmes Engineering Works, Chas. F. 116
Errington, F. A. 93
Evans Friction Cone Co. 88
Excelsior Needle Co. 112

Fales, L. F. 122
Fawcus Machine Co. 104
Fay & Scott 66
Fay Machine Tool Co. 42
Fellows Gear Shaper Co. 34
Felton, Sibley & Co. 110
Ferracute Machine Co. 106
Firth-Sterling Steel Co. 119
Fitchburg Machine Works 108
Flather Mfg. Co., E. J. 106
Flather Planer Co., Mark 110
Foote Bros. Gear & Mach. Co. 106
Foote-Burt Co. 102
Ford Chain Block Co. 90
Fosdick Machine Tool Co. 16
Foster Machine Co. 108
Franklin Mfg. Co. 120

Gang Co., W. E. 89
Gannett Electrical Co. 107
Gardner Machine Co. 87
Garvin Machine Co. 129
Garwood Electric Co. 101
Gem Mfg. Co. 91
General Electric Co. 100
Geometric Tool Co. 15
Gilbert & Barker Mfg. Co. 122
Gilbert, Harris & Co. 94
Gisholt Machine Co. 99
Goodell-Pratt Co. 124
Gorton Machine Co., Geo. 91
Gould & Eberhardt 97
Graham Mfg. Co. 94
Grant Gear Works 104
Grant Mfg. & Mach. Co. 114
Grant Nail & Supply Co. 128
Gray Co., G. A. 28
Gray & Prior Machine Co. 107
Greaves, Klusman & Co. 108
Greene, Tweed & Co. 85
Greenfield Machine Co. 87
Grönkvist Drill Chuck Co. 93

Hamilton Machine Tool Co. ... 39
Hammacher, Schlemmer & Co. 81
Hampden Machine Screw Co. 115
Hardinge Bros. 130
Harrington, Son & Co., Edw. 89
Hart & Cooley Co. 98
Hendey Machine Co. 77
Henry & Wright Mfg. Co. 99
Hess-Bright Mfg. Co. 49
Hisey-Wolf Machine Co. 102
Hoefer Mfg. Co. 36
Hoggson & Pettis Mfg. Co. 93
Horsburgh & Scott Co. 104
Horton Machine Co., S. E. 92
Horton & Son Co., E. 92
Hoskins Mfg. Co. 123
Hurlbut-Rogers Mach. Co. 91

Independent Pneu. Tool Co. ... 116
Industrial Oxygen Co. 121
Ingersoll Milling Mach. Co. ... 114
Ingersoll-Rand Co. 117
International Corr. Schools .. 125
International Mach. Tool Co. 134

Jackson Vise & Tool Co. 94
Jacobs Mfg. Co. 95
Jefferson Union Co. 125
Johnson Machine Co., Carlyle. 96
Jones & Lamson Mach. Co., 12, 13 and 66

Kearney & Trecker Co. 26

PAGE

Kelly Co., R. A. 111
Kempsmith Mfg. Co. 27
Kern Machine Tool Co. 107
Keuffel & Esser Co. 103

Landis Machine Co. 123
Landis Tool Co. 73
Lapointe Machine Tool Co. ... 103
Lea Equipment Co. 107
LeBlond Mach. Tool Co., R. K., 79 and 4th cover
Link-Belt Co. 47
Livermore, Homer F. 123
Lodge & Shipley Machine Tool Co. 4
Long & Allstatter Co. 112
Lucas Machine Tool Co. 94
Lumen Bearing Co. 124

Manning, Maxwell & Moore. .. 131
Manufacturing Equipment and Engineering Co. 99
Manville Machine Co., E. J. .. 112
Maris Bros. 88
Marshall & Huschart Mch. Co. .....127 and 128
Massachusetts Saw Works ... 124
McCabe, J. J. .....109 and 126
McCabe Machine Co. 127
Meisselbach-Catucci Mfg. Co. 106
Merritt, Jos. 66
Millers Falls Co. 96
Milton Mfg. Co. 41
Mitts & Merrill 91
Modern Tool Co. 113
Moore Co., Franklin 90
Morrow Mfg. Co. 93
Morse Chain Co. 98
Morse Twist Drill and Mach. Co. 75
Morton Mfg. Co. 124
Motch & Merryweather Machinery Co. 126
Mueller Machine Tool Co. ... 113

National-Acme Mfg. Co. 134
National Machine & Tool Co. . 113
National Machine Co. 107
National Machinery Co. 128
National Tube Co. 115
Nazel Engr. & Machine Wks. . 111
New Britain Machine Co. 91
New Haven Mfg. Co. 40
New Process Raw Hide Co. .. 106
Newark Gear Cutting Machine Co. 106
Newton Machine Tool Wks. .. 19
Niagara Machine Tool Works Co. 112
Nicholson & Co., W. H. 113
Nicholson File Co. 17
Niles-Bement-Pond Co. 2d cover, 51 to 58 and 127
Northern Engineering Wks. ... 88
Norton Co. 85
Norton Grinding Co. 84
Nuttall Co., R. D. 104

Obermayer Co., S. 124
Oesterlein Machine Co. 129
O. K. Tool Holder Co. 125
One-Lock Reamer Co. 113
Oneida Steel Pulley Co. 90
Osgood, J. I. 125
Owen Machine Tool Co. 97

Page-Storms Drop Forge Co. . 91
Palmer Bros. 110
Pangborn, Thomas W. Company 117
Parker Co., Chas. 94
Pawling & Harnischfeger Co. . 88
Paxson Co., J. W. 116
Philadelphia Gear Works 104
Potter & Johnston ....20 and 21
Poorman & Co., J. E. 129
Pratt & Whitney Co. .3, 59 to 64
Pratt Chuck Co. 92
Pratt Institute 125
Prentice & Co., Inc., Geo. G. . 15
Prentice Bros. Co. 29
Prentiss Tool & Supply Co. ... 126

Quality Saw & Tool Works ... 111
Queen City Machine Tool Co. 102
Quride Co. 106

Ransom Mfg. Co. 86
Ready Tool Co. 99
Reed Co., F. E. 27
Reed Mfg. Co. 94
Reeves Pulley Co. 88
Reliance Electric & Engineering Co. 103
Rider-Bagg Co. 123
Risdon Tool & Mach. Co., Inc. 110
Rivett Lathe Mfg. Co. ..3d cover
Robinson & Co., W. A. 115
Rochester Boring Machine Co. 31
Rockford Drilling Mach. Co. . 130
Rockford Machine Tool Co. ... 110
Rockwell Furnace Co. 124
Rockwood Mfg. Co. 88

PAGE

Rogers & Hubbard Co. 122
Root Co., C. J. 110
Roth Bros. & Co. 102
Rowbottom Machine Co. 87

S. K. F. Ball Bearing Co. 90
Safety Emery Wheel Co. 86
Sanford Mfg. Co., F. C. 123
Saunders' Sons, D. 107
Sawyer Gear Works 104
Schieren Co., Chas. A. 112
Schmidt, F. L. 111
Schumacher & Boye 22
Sebastian Lathe Co. 109
Sellers & Co., Inc., Wm. 32
Seneca Falls Mfg. Co. 109
Shaw Electric Crane Co. 88
Shepard Electric Crane and Hoist Co. 88
Shore Instrument & Mfg. Co. 123
Shuster Co., F. B. 125
Sibley Mach. Tool Co. 44
Simonds Mfg. Co. 111
Skinner Chuck Co. 92
Slack Manufacturing Co. 44
Sloan & Chace Mfg. Co. 41
Slocomb Co., J. T. 115
Smart Mfg. Co., A. J. 111
Smith & Mills Co. 106
Smith Countershaft Co. 90
Smooth-On Mfg. Co. 122
South Bend Machine Tool Co. 108
Spacke Mach. Co., F. W. 116
Sprague Electric Co. 101
Springfield Machine Tool Co. . 65
Springfield Mfg. Co. 87
Standard Engineering Wks. . 106
Standard Gauge Steel Co. 121
Standard Tool Co. 25
Standard Welding Co. 120
Stark Tool Co. 103
Starrett Co., L. S. 26
Sterling Emery Wheel Co. 86
Stoever Fdry. & Mfg. Co. 125
Sullivan Machinery Co. 117

Tabor Mfg. Co. 28
Tate, Jones & Co. 122
Taylor & Fenn Co. 115
Taylor-Wilson Mfg. Co. 105
Tindel-Morris Co. 111
Toledo Electric Welder Co. ... 121
Toomey, Frank 128
Townsend Mfg. Co., H. P. 114
Trimont Mfg. Co. 96
Triumph Electric Co. 103
Trump Bros. Machine Co. 93

Underwood & Co., H. B. 125
Union Mfg. & Drop Forge Co. 123
Union Mfg. Co. 93
Union Twist Drill Co. 77
United Bearings Co. 91
United Engineering & Fdry. Co. 40
U. S. Electrical Tool Co. 102
Utica Drop Forge & Tool Co. . 43

Van Dorn & Dutton Co. 106
Vanderbeek Tool Wks. 42
Vandyck Churchill Co. 128
Veeder Mfg. Co. 115
Vitrified Wheel Co. 87
Von Wyck Mach. Tool Co. 108
Vulcan Crucible Steel Co. 124

Walcott & Wood Mach. Tool Co. 108
Walker & Co., O. S. ....4th cover
Waltham Machine Works 108
Waltham Watch Tool Co. 129
Walworth Mfg. Co. 66
Ward & Sons, Edgar T. 120
Warner & Swasey Co. 33
Warner Instrument Co. 114
Washburn Shops 107
Watson-Stillman Co. 125
Webster & Perks Tool Co., The. 86
Weeks, C. S. 125
Wells & Son, F. E. 86
Wells Bros. Co. 34
West Haven Mfg. Co. 110
Western Machine Tool Wks. . 125
Western Tool & Mfg. Co. 110
Westinghouse Elec. & Mfg. Co. 101
Wheeling Mold and Foundry Co. 108
Whitlock Coil Pipe Co. 122
Whitman & Barnes Mfg. Co. . 38
Whitney Mfg. Co. 60
Whiton Machine Co., D. E. .. 93
Wiley & Russell Mfg. Co. 113
Williams & Co., J. H. .43 and 83
Wilmarth & Morman Co. 87
Windsor Machine Co. 16
Wood Turret Machine Co. 110
Woodward & Powell Planer Co. 91
Worcester Machine Screw Co. 110
Wormer Machinery Co., C. C. 127
Wright Wrench & Forging Co. 115

Yale & Towne Mfg. Co. 90

CLASSIFIED INDEX *to* ARTICLES ADVERTISED

Abrasive Materials
American Emery Wheel Co... 86
Carborundum Co..... 38
Dickinson, Thos. L..... 66
Norton Co..... 85
Safety Emery Wheel Co..... 86
Vitrified Wheel Co..... 87

Accumulators, Hydraulic
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Watson-Stillman Co.....125

Air Lifts
Ingersoll-Rand Co.....117

Alloys
American Vanadium Co.....118

Alundum
See Grinding Wheels.

Arbor Presses
Barnes Co., W. F. & John.... 14
Crane Puller Co..... 90
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Wilmarth & Morman Co..... 87

Arbors
Brown & Sharpe Mfg. Co., 71 and 4th cover
Cleveland Twist Drill Co., 4th cover
Morse Twist Drill & Machine Co. 75
Pratt Chuck Co..... 92
Skinner Chuck Co..... 92
Union Mfg. Co..... 93
Union Twist Drill Co..... 77
Wilmarth & Morman Co..... 87

Balls, Steel
Abbott Ball Co..... 90
Boker & Co., Hermann..48 and 75
Bretz Co., J. S.....123

Barrels, Tumbling
Abbott Ball Co..... 90

Bars, Boring
Beaman & Smith Co...25 and 92
Cleveland Twist Drill Co., 4th cover
Elmes Engineering Works, Chas. F.....116
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Underwood Co., H. B.....125

Bearings, Ball and Roller
Arguto Oiliess Bearing Co., 1st cover
Auburn Ball Bearing Co..... 90
Boston Gear Works.....104
Bretz Co., J. S.....123
Hess-Bright Mfg. Co..... 49
S. K. F. Ball Bearing Co..... 90
United Bearings Co..... 91

Bearings, Bronze
Rider-Bagg Co.....123

Belt Clamps
Hoggson & Pettis Mfg. Co.... 93

Belt Dressing
Dixon Crucible Co., Joseph...122
Schieren Co., Chas. A.....112

Belt Fasteners
Bristol Co.....4th cover
Greene, Tweed & Co..... 85

Belt Filler
Schieren Co., Chas. A.....112

Belting, Leather
Colonial Leather Co.....106
Schieren Co., Chas. A.....112

Benches, Work
Brown & Sharpe Mfg. Co., 71 and 4th cover
Manufacturing Equipment and Engineering Co..... 99

Bending Machinery, Hydraulic
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32

Bending Machines, Plate
Long & Allstatter Co.....112
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32

Bending Machines, Power
National Machry. Co.....128
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32

Blanks, Nuts and Screw
Electric Welding Products Co.124

Blocks, Chain
See Hoists, Hand

Blocks, Die
Nicholson & Co., W. H.....113

Blowers
American Gas Furnace Co....119
Chicago Flexible Shaft Co...118
Garwood Electric Co.....101
General Electric Co.....100
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Roth Bros. & Co.....102
Westinghouse Elec. & Mfg. Co.101

Blue Print Machines
Buckeye Engine Co.....110
Keuffel & Esser Co.....103

Blue Print Paper
Buckeye Engine Co.....110
Keuffel & Esser Co.....103

Bolt and Nut Machinery
Acme Mchry. Co.....114
Davis Machine Co., W. P..... 45
Detrick & Harvey Mach. Co..102
Foote-Burt Co.....102
Harrington, Son & Co., Edwin. 89
Landis Machine Co.....123
Manville Mach. Co., E. J.....112
McCabe, J. J.....109 and 126
Motch & Merryweather Machinery Co.....126
National-Acme Mfg. Co.....134
National Machinery Co.....128
Newton Machine Tool Wks... 19
New Haven Mfg. Co..... 40
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Prentiss Tool & Supply Co....126
Sellers & Co., Wm..... 32
Standard Engineering Co....106
Webster & Perks Tool & Machine Co..... 86
Wiley & Russell Mfg. Co.....113

Bolts and Nuts
Electric Welding Products Co.124
National-Acme Mfg. Co.....134

Bone for Case-Hardening
Rogers & Habbard Co.....122

Books, Technical
International Textbook Co....125
McGraw-Hill Book Co.....125

Boosters
Burke Electric Co.....102
Garwood Electric Co.....101
General Electric Co.....100
Roth Bros. & Co.....102
Westinghouse Elec. & Mfg. Co.101

Boring Machines, Portable
Rochester Boring Machine Co. 31

Boring, Drilling and Milling Machines, Horizontal
Barnes Co., W. F. & John. 14
Beaman & Smith Co..25 and 92
Betts Machine Co..... 9
Detrick & Harvey Mach. Co.. 45
Fitchburg Machine Works. 108
Fosdick Mach. Tool Co..... 16
Gisholt Machine Co..... 99
Hill, Clarke & Co...110 and 125
Hoefer Mfg. Co..... 36
Lucas Machine Tool Co..... 94
Manning, Maxwell & Moore...131
McCabe, J. J.....109 and 126
Motch & Merryweather Machinery Co.....126
New Haven Mfg. Co..... 40
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Prentiss Tool & Supply Co...126
Rochester Boring Machine Co. 31
Rockford Drilling Mach. Co...130
Sellers & Co., Wm..... 32
Springfield Mach. Tool Co..... 65
Vandyck Churchill Co.....128

Boring and Turning Mills, Vertical
American Tool Wks. Co..... 8
Baker Bros. 89
Baush Mach. Tool Co..... 24
Betts Machine Co..... 9
Bullard Machine Tool Co., 132 and 133
Flather Mfg. Co., E. J.....106
Gisholt Machine Co..... 99
Harrington, Son & Co., Edwin. 89
Lucas Machine Tool Co..... 94
Manning, Maxwell & Moore...131
Marshall & Huschart Machinery Co.....127 and 128
McCabe, J. J.....109 and 126
Mitts & Merrill..... 91
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co. 2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32
Wormer Mchry. Co., C. C....127

Boring Tools
Armstrong Bros. Tool Co.... 97
Western Tool & Mfg. Co.....110

Brazing
Industrial Oxygen Co.....121
Sanford Mfg. Co., F. C.....123

Broaching Machines
Harrington, Son & Co., Edwin. 89
Hill, Clarke & Co...110 and 125
Lapointe Mach. Tool Co.....103

Buckets, Coal
Link-Belt Co..... 47

Bulldozers
Bliss Co., E. W..... 23
National Machinery Co.....128
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Prentiss Tool & Supply Co...126

Burnishing Machinery
Abbott Ball Co..... 90

Butt Drilling and Milling Machines
Shuster Co., F. B.....125

Cabinets, Tool
Armstrong Bros. Tool Co.... 97
Hammacher, Schlemmer & Co. 81
Morse Twist Drill & Mach. Co. 75

Calipers
Brown & Sharpe Mfg. Co., 71 and 4th cover
Gilbert, Harris & Co..... 94
Slocomb Co., J. T.....115
Starrett Co., L. S..... 26

Cam Cutting Machinery
Manville Machine Co., E. J..112
Rowbottom Machine Co..... 87

Cams
Bilgram Machine Works.....104
Boston Gear Works.....104
National Mach. & Tool Co....113
Rowbottom Machine Co..... 87

Carbonizing
American Gas Furnace Co...119
Bridgeport Metal Treating Co.122

Carborundum
See Grinding Wheels.

Cars, Industrial
Link-Belt Co..... 47

Case-Hardening
American Gas Furnace Co...119
Bridgeport Metal Treating Co.122
Chicago Flexible Shaft Co....118
Rockwell Furnace Co.....124
Rogers & Hubbard Co.....122
Williams & Co., J. H..43 and 83

Castings, Aluminum
Rider-Bagg Co.....123

Castings, Brass and Bronze
Clum & Atkinson.....124
Livermore, Homer F.....123
Lumen Bearing Co.....124
Rider-Bagg Co.....123
Whitlock Coil Pipe Co.....122

Castings, Die Molded
Doehler Die Casting Co.....121
Franklin Mfg. Co.....120
Veeder Mfg. Co.....115

Castings, Iron
Brown & Sharpe Mfg. Co., 71 and 4th cover
Buffalo Fdry. & Mach. Co....112
Fales, L. F.....122
Link-Belt Co..... 47
Livermore, Homer F.....123
Springfield Machine Tool Co.. 65
Taylor & Fenn Co.....115
Veeder Mfg. Co.....115
Wheeling Mold & Fdry. Co...108

Castings, Steel
Hess-Bright Mfg. Co..... 49
Livermore, Homer F.....123
United Engr. & Fdry. Co..... 40

Castings, Vanadium
American Vanadium Co.....118

Cast Iron Brazing
Felton, Sibley & Co.....110
Industrial Oxygen Co.....121
Sanford Mfg. Co., F. G.....123

Cement, Iron
Obermayer Co., S.....124
Smooth-On Mfg. Co.....122

Centering Machines
Hendey Machine Co..... 77
McCabe, J. J.....109 and 126
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Pratt & Whitney Co..3, 59 to 64
Wells & Son Co., F. E..... 86
Whiton Mach. Co., D. E..... 93

Centers, Planer
Cincinnati Planer Co..... 37
Fay & Scott..... 66
Morse Twist Drill & Mach. Co. 75
New Haven Mfg. Co..... 40
Pratt & Whitney Co..3, 59 to 64
Reed Co., F. E..... 27
Woodward & Powell Planer Co. 91

Chains, Driving
Boston Gear Works.....104
Diamond Chain & Mfg. Co...129
Link-Belt Co..... 47
Morse Chain Co..... 98
Whitney Mfg. Co..... 69

Chucking Machines
Acme Machine Tool Co..... 36
American Tool Wks. Co..... 8
Bardons & Oliver.....125
Brown & Sharpe Mfg. Co., 71 and 4th cover
Cleveland Automatic Machine Co. 18
Garvin Machine Co..... 87
Gisholt Machine Co..... 99
LeBlond Mach. Tool Co., R. K., 79 and 4th cover
McCabe, J. J.....109 and 126
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Potter & Johnston.....20 and 21
Reed Co., F. E..... 27
Warner & Swasey Co..... 33
Windsor Machine Co..... 16

Chucks, Drill
Almond Mfg. Co., T. R..... 92
Brown & Co., R. H..... 93
Celfor Tool Co.....114
Cleveland Twist Drill Co., 4th cover
Cushman Chuck Co..... 94
Grönkvist Drill Chuck Co.... 93
Horton & Son Co., E..... 92
Jacobs Mfg. Co..... 95
Modern Tool Co.....113
Morrow Mfg. Co..... 93
Morse Twist Drill & Mach. Co. 75
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Pratt Chuck Co..... 92
Skinner Chuck Co..... 92
Standard Tool Co..... 25
Trump Bros. Mach. Co..... 93
Union Mfg. Co..... 93
Whitman & Barnes Mfg. Co.. 38
Whitney Mfg. Co..... 69
Whiton Mach. Co., D. E..... 93
Wiley & Russell Mfg. Co.....113

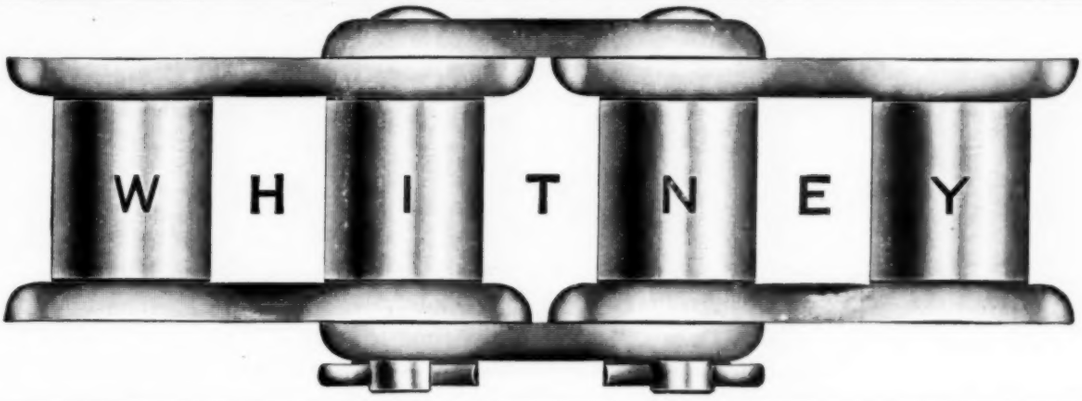
Chucks, Lathe
Cushman Chuck Co..... 94
Gisholt Machine Co..... 99
Hoggson & Pettis Mfg. Co.... 93
Horton & Son Co., E..... 92
Horton Machine Co., S. E.... 92
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Pratt Chuck Co..... 92
Skinner Chuck Co..... 92
Union Mfg. Co..... 93
Whiton Mach. Co., D. E..... 93

Chucks, Magnetic
Walker & Co., O. S.....4th cover

Chucks, Planer
Cincinnati Planer Co..... 37
Harrington & Son Co., Edwin. 89
New Haven Mfg. Co..... 40
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Skinner Chuck Co..... 92
Union Mfg. Co..... 93

Chucks, Split
American Watch Tool Co....108
Ames & Co., B. C.....108
Hardinge Bros.....130
Rivett Lathe Mfg. Co...3d cover
Sloan & Chace Mfg. Co..... 41
Stark Tool Co.....103

Circuit Breakers
General Electric Co.....100
Westinghouse Elec. & Mfg. Co.101

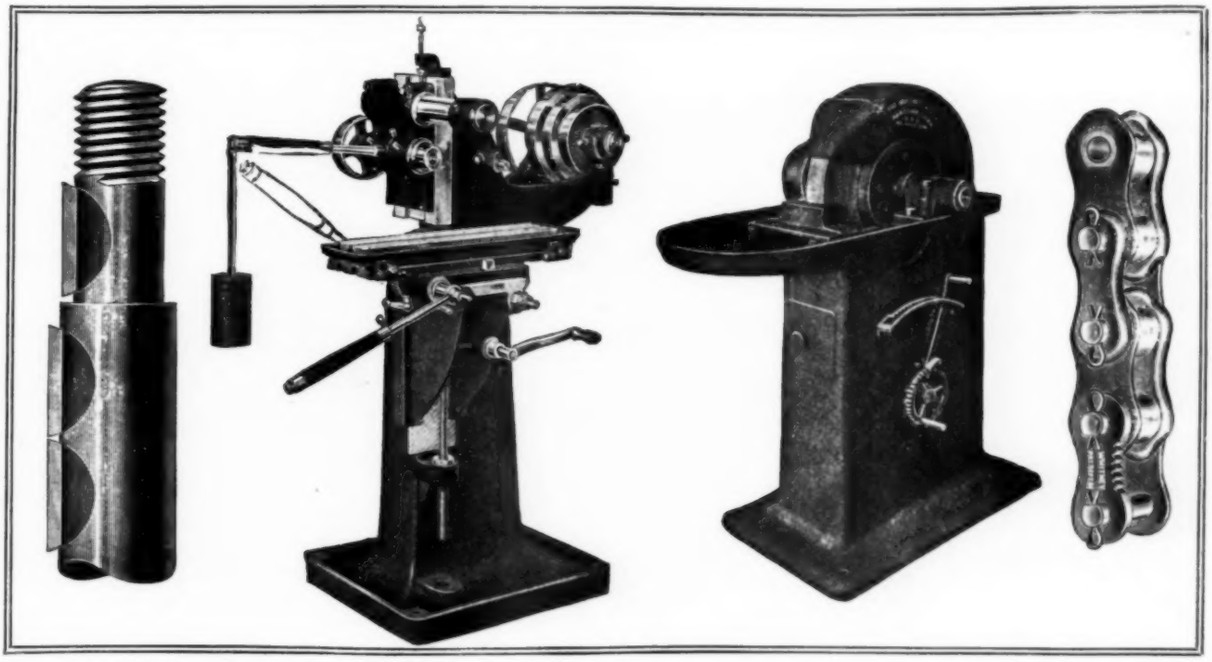


Chain Department

Roller Chains, Block Chains, Chain Belts, Quiet Chains, for Automobiles, Commercial Cars, Motorcycles, Bicycles, Machinery, etc.

Machine Department

Hand (feed) Milling Machines, 20-inch Water Tool Grinders, Keys and Cutters for the Woodruff Patent System of Keying, Presto Drill Chucks, Collets and Friction Tapping Devices.



The Whitney M'f'g Co., Hartford, Conn.

Clamps
Brown & Sharpe Mfg. Co., 71 and 4th cover
Hammacher, Schlemmer & Co. 81
Hoggson & Pettis Mfg. Co.... 93
Starrett Co., L. S..... 26
Western Tool & Mfg. Co.....110
Williams & Co., J. H..43 and 83

Clutches, Friction
American Tool & Machine Co.114
Caldwell & Sons Co., H. W... 90
Eastern Machinery Co..... 90
Evans Friction Cone Co..... 88
Johnson Mach. Co., Carlyle.. 96
Link-Belt Co..... 47
New Haven Mfg. Co..... 40
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Oesterlein Machine Co.....129
Reeves Pulley Co..... 88
Wheeling Mold & Fdry. Co...108

Coal Handling Machinery
Link-Belt Co..... 47

Compound, Pipe Joint
Dixon Crucible Co., Joseph...122
Smooth-On Mfg. Co.....122

Compressors, Air
Blaisdell Mchy. Co..116 and 124
Bury Compressor Co.....116
Clayton Air Compressor Wks. 116
Dallett Co., Thos. H.....117
Independent Pneu. Tool Co...116
Ingersoll-Rand Co. 117
Spacke Mach. Co., F. W.....116
Sullivan Machinery Co.....117

Compressors, Gas
Bury Compressor Co.....116
Ingersoll-Rand Co.....117

Conduit, Interior
Sprague Electric Co.....101

Cones, Friction
Evans Friction Cone Co..... 88

Connecting Rods and Straps
Elec. Welding Products Co...124
Tindel Morris Co.....111

Contract Work
Blanchard Machine Co.....114
Fales, L. F.....122
Merritt, Jos..... 66
Morrow Mfg. Co..... 93
Risdon Tool & Mach. Co.....110
Rowbottom Machine Co..... 87
Union Mfg. & Drop Forge Co.123
Weeks, C. S.....125

Controllers and Starters, Electric
Cushman Electric Co.....103
General Electric Co.....100
Westinghouse Elec. & Mfg. Co.101

Conveying Machinery
Brown Hoisting Mchry. Co.. 88
Link-Belt Co..... 47
Manning, Maxwell & Moore...131

Coping Machines
Long & Allstatter Co.....112
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127

Corundum
See Grinding Wheels.

Cotter Pin Machinery
Shuster Co., F. B.....125

Cotters
Cleveland Twist Drill Co., 4th cover
Morse Twist Drill & Mach. Co. 75
Shuster Co., F. B.....135
Standard Tool Co..... 25
Union Twist Drill Co..... 77
Whitman & Barnes Co..... 38

Counterbores
Cleveland Twist Drill Co., 4th cover
Morse Twist Drill & Mach. Co. 75
Pratt & Whitney Co..3, 59 to 64
Slocomb Co., J. T.....115
Starrett Co., L. S..... 26

Counters, Revolution
Grant Mfg. & Machine Co.....114
Root Co., C. J.....110
Veeder Mfg. Co.....115

Countershafts
Almond Mfg. Co., T. R..... 92
Brown & Sharpe Mfg. Co., 71 and 4th cover
Coates Clipper Mfg. Co.....128
Dill Slotter People..... 91
Evans Friction Cone Co..... 88
Garvin Machine Co.....129
LeBlond Mach. Tool Co., R. K., 79 and 4th cover
McCabe, J. J.....109 and 126
Norton Grinding Co..... 84
Safety Emery Wheel Co..... 86
Smith Countershaft Co..... 90

Countershafts, Air
Manufacturing Equipment and Engineering Co..... 99

Countershafts, Friction
Dill Slotter People..... 91
Evans Friction Cone Co..... 88
Warner & Swasey..... 33
Wilmarth & Morman Co..... 87

Counting and Printing Wheels
Doehler Die Casting Co.....121
Franklin Mfg. Co.....120

Couplers, Hose
Greene, Tweed & Co..... 85
Independent Pneu. Tool Co...117
Ingersoll-Rand Co.....117

Couplings
Almond Mfg. Co., T. R..... 92
Caldwell & Sons Co., H. W... 90
Davis Machine Co., W. P..... 45
Nicholson & Co., W. H.....113
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32
Standard Gauge Steel Co.....121

Cranes
Brown Hoisting Mchry. Co... 88
Link-Belt Co..... 47
Manning, Maxwell & Moore...131
Maris Bros..... 88
Moore Co., Franklin..... 90
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Northern Engineering Works. 88
Obermayer Co., S.....124
Pawling & Harnischfeger Co. 88
Sellers & Co., Wm..... 32
Shaw Electric Crane Co..... 88
Shepard Electric Crane & Hoist Co..... 88
United Engr. & Fdry. Co..... 40
Vandyck Churchill Co.....128
Yale & Towne Mfg. Co..... 90

Crank Pin Turning Machines
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Underwood Co., H. B.....125

Crank Shafts
Tindel Morris Co.....111

Crucibles
Dixon Crucible Co., Jos.....122
Obermayer Co., S.....124

Crushers
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127

Cupolas and Ladles, Foundry
Obermayer Co., S.....124
Paxson Co., J. W.....116

Cutters, Milling
Adams Co.....105
Becker Milling Machine Co., 23 and 120
Bliss Mfg. Co., E. C.....107
Boker & Co., Hermann..48 and 75
Brown & Sharpe Mfg. Co., 71 and 4th cover
Cleveland Twist Drill Co., 4th cover
Ingersoll Milling Machine Co.114
Kearney & Trecker..... 26
Morse Twist Drill & Mach. Co. 75
Pratt & Whitney Co..3, 59 to 64
Sloan & Chace Mfg. Co..... 41
Standard Tool Co..... 25
Tabor Mfg. Co..... 28
Union Twist Drill Co..... 77
Ward & Son, Edgar T.....120
Whitney Mfg. Co..... 69

Cutting-Off Machines
Armstrong Bros. Tool Co..... 97
Bignall & Keeler Mfg. Co.....110
Brown & Sharpe Mfg. Co., 71 and 4th cover
Davis Machine Co., W. P..... 45
Hurlbut Rogers Mach. Co..... 91
McCabe, J. J.....109 and 126
Newton Machine Tool Wks... 19
Pratt & Whitney Co..3, 59 to 64
Prentiss Tool & Supply Co...126
Slack Mfg. Co..... 44
Tindel Morris Co.....111
Warner & Swasey Co..... 33

Cutting-Off Tools
Armstrong Bros. Tool Co..... 97
Billings & Spencer Co..... 98
Cleveland Twist Drill Co., 4th cover
Davis-Bournonville Co.....123
O. K. Tool Holder Co.....125
Pratt & Whitney Co..3, 59 to 64
Ready Tool Co..... 99
Western Tool & Mfg. Co.....110

Cyclometers
Veeder Mfg. Co.....115

Diamond Tools
American Emery Wheel Co... 86
Dickinson, Thos. L..... 66
Safety Emery Wheel Co..... 86

Dies, Sheet Metal
American Tube & Stamping Co.131
Bliss Mfg. Co., E. C.....107
Bliss Co., E. W..... 23
Consolidated Press & Tool Co. 112
Ferracute Machine Co.....106
New Haven Mfg. Co..... 40
Niagara Machine & Tool Wks.112
Pratt & Whitney Co..3, 59 to 64
Risdon Tool & Mach. Co.....110
Waltham Machine Works....108

Dies, Sub-Press
American Watch Tool Co....108
Pratt & Whitney Co..3, 59 to 64
Sloan & Chace Mfg. Co..... 41
Waltham Machine Works....108

Dies, Threading, Opening
Boker & Co., Hermann..48 and 75
Errington, F. A..... 93
Foote-Burt Co.....102
Geometric Tool Co..... 15
Jones & Lamson Mach. Co., 12, 13 and 66
Modern Tool Co.....113
Pratt & Whitney Co..3, 59 to 64
Warner & Swasey Co..... 33

Drafting Machines
Keuffel & Esser Co.....103

Drawing Boards and Tables
Keuffel & Esser Co.....103
Washburn Shops.....107

Drawing Materials
Keuffel & Esser Co.....103

Drill Speeder
Graham Mfg. Co..... 94

Drilling Machines, Bench
Barnes Co., W. F. & John.... 14
Goodell-Pratt Co.....124
Hoefer Mfg. Co..... 36
Pratt & Whitney Co..3, 59 to 64
Prentice Bros. Co..... 29
Rockford Drilling Mach. Co..130
Sloan & Chace Mfg. Co..... 41
U. S. Electrical Tool Co.....102

Drilling Machines, Boiler
American Tool Works Co..... 8
Cincinnati Bickford Tool Co., 10 and 11
Foote-Burt Co.....102
McCabe, J. J.....109 and 126
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Prentice Bros. Co..... 29
Sellers & Co., Wm..... 32

Drilling Machines, Breast
Goodell-Pratt Co.....124

Drilling Machines, Multiple Spindle
American Tool Wks. Co..... 8
Baker Bros. 89
Barnes Co., W. F. & John.... 14
Barnes Drill Co..... 85
Baush Mach. Tool Co..... 24
Cincinnati Bickford Tool Co., 10 and 11
Flather Planer Co., Mark.....110
Foote-Burt Co.....102
Fosdick Mach. Tool Co..... 16
Garvin Machine Co.....129
Hardinge Bros.....130
Harrington, Son & Co., Edwin. 89
Henry & Wright Mfg. Co..... 99
Hill, Clarke & Co...110 and 125
Hoefer Mfg. Co..... 36
Manning, Maxwell & Moore...131
McCabe, J. J.....109 and 126
Newton Mach. Tool Works... 19
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Pratt & Whitney Co..3, 59 to 64
Prentice Bros. Co..... 29
Prentiss Tool & Supply Co...126
Rockford Drilling Mach. Co..130
Sellers & Co., Wm..... 32
Taylor & Fenn Co.....115

Drilling Machines, Portable
Coates Clipper Mfg. Co.....128
Dallett, Thos. H.....117
Gem Mfg. Co..... 91
Ingersoll-Rand Co.....117
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Rochester Boring Machine Co. 31
U. S. Electrical Tool Co.....102

Drilling Machines, Radial
American Tool Works Co..... 8
Baush Mach. Tool Co..... 24
Cincinnati Bickford Tool Co., 10 and 11
Detrick & Harvey Mach. Co..102
Dreses Mach. Tool Co..... 22
Fitchburg Machine Works, 108
Foote-Burt Co.....102
Fosdick Mach. Tool Co..... 16
Gang Co., Wm. E..... 89
Hamilton Mach. Tool Co..... 39
Harrington, Son & Co., Edwin. 89
Manning, Maxwell & Moore...131
Marshall & Huschart Machry. Co. .....127 and 128
McCabe, J. J.....109 and 126
Mueller Mach. Tool Co.....113
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Prentice Bros. Co..... 29
Sellers & Co., Wm..... 32
Wormer Mchy. Co., C. C.....127

Drilling Machines, Rail
Foote-Burt Co.....102
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32
Standard Tool Co..... 25

Drilling Machines, Turret
Fay Machine Tool Co..... 42
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Vanderbeek Tool Works..... 42

Drilling Machines, Upright
Aurora Tool Works.....125
Baker Bros. 89
Barnes Co., W. F. & John.... 14
Barnes Drill Co..... 85
Beaman & Smith Co..25 and 92
Celfor Tool Co.....114
Cincinnati Bickford Tool Co., 10 and 11
Davis Machine Co., W. P..... 45
Foote-Burt Co. 1C2
Fosdick Mach. Tool Co..... 16
Garvin Machine Co.....129
Gould & Eberhardt..... 97
Hamilton Machine Tool Co... 39
Harrington, Son & Co., Edwin. 89
Henry & Wright Mfg. Co..... 99
Hill, Clarke & Co...110 and 125
Hoefer Mfg. Co..... 36
Kern Mach. Tool Co.....107
Manning, Maxwell & Moore...131
Marshall & Huschart Machry. Co. .....127 and 128
McCabe, J. J.....109 and 126
Morse Twist Drill & Mach. Co. 75
New Haven Mfg. Co..... 40
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Pratt & Whitney Co..3, 59 to 64
Prentice Bros. Co..... 29
Rockford Drilling Mach. Co..130
Sellers & Co., Wm..... 32
Sibley Machine Tool Co..... 44
Sloan & Chace Mfg. Co..... 41
Taylor & Fenn Co.....115
Washburn Shops.....107
Whitney Mfg. Co..... 69
Wiley & Russell Mfg. Co.....113
Wormer Machry. Co., C. C....127

Drills, Center
Cleveland Twist Drill Co., 4th cover
Morse Twist Drill & Mach. Co. 75
Pratt & Whitney Co..3, 59 to 64
Slocomb Co., J. T.....115
Standard Tool Co..... 25

Drills, Electric
Independent Pneu. Tool Co...117

Drills, Flat
Celfor Tool Co.....114
Whitman & Barnes Mfg. Co.. 38

Drills, Hand
Coates Clipper Mfg. Co.....128
Ingersoll-Rand Co.....117
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
U. S. Electrical Tool Co.....102

Drills, Pneumatic
Clayton Air Compressor Wks. 116
Independent Pneu. Tool Co...117
Ingersoll-Rand Co.....117

Drills, Ratchet
Armstrong Bros. Tool Co..... 97
Billings & Spencer Co..... 98
Boker & Co., Hermann..48 and 75
Cleveland Twist Drill Co., 4th cover
Greene, Tweed & Co..... 85
Parker Co., Chas..... 94
Pratt & Whitney Co..3, 59 to 64
Standard Tool Co..... 25

Drills, Rock
Ingersoll-Rand Co.....117

The mechanic who has to make measurements of angles which do not require the use of a vernier knows he can get accurate results with the

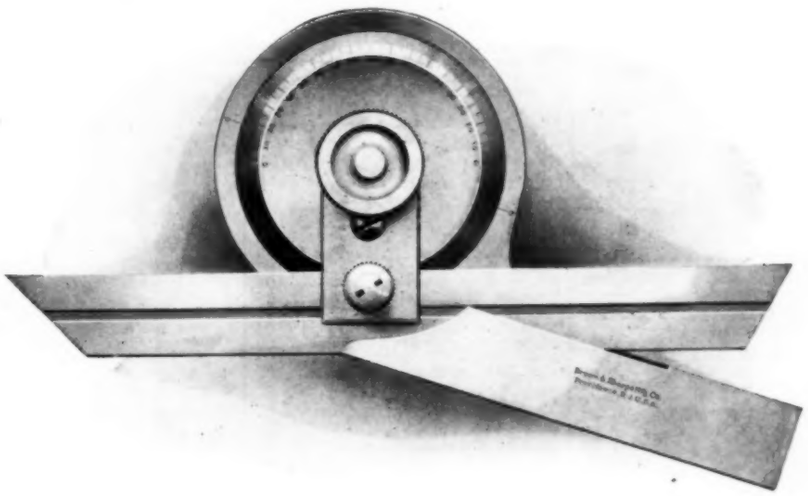
B. & S. Improved Bevel Protractor

There are many times when a mechanic needs a tool to lay out or establish an angle quickly and accurately but does not need the finer degree of accuracy secured with a vernier. This protractor was designed for this purpose, and, although it has been on the market only a short time, it has proved very popular.

It is made flat on one side so that it can lie flat on the paper or work, a feature that will be instantly apparent to the users of the instrument.

The protractor is adapted for work on which other protractors cannot be used, as the blade can be moved back and forth its entire length and clamped independently of the dial. The grooves and angles are made with rounded corners that do not collect dirt, thus aiding the accuracy.

We also make the IMPROVED UNIVERSAL BEVEL PROTRACTOR with a vernier.



We have a new folder which describes the tool fully.

Other protractors are shown in our General Catalogue.

Brown & Sharpe Mfg. Co.,
Providence, R. I., U. S. A.

Dust Exhaust and Collector System
Pangborn, Thomas W. Company 117

Dynamos
Burke Electric Co. 102
Electro Dynamic Co. 102
Garwood Electric Co. 101
General Electric Co. 100
Roth Bros. & Co. 102
Sprague Electric Co. 101
Triumph Electric Co. 103
Westinghouse Elec. & Mfg. Co. 101

Electrical Supplies
Cushman Electric Co. 103
Electro Dynamic Co. 102
Garwood Electric Co. 101
General Electric Co. 100
Roth Bros. & Co. 102
Triumph Electric Co. 103
Westinghouse Elec. & Mfg. Co. 101

Elevators
Albro-Clem Elevator Co. 106
Eastern Machinery Co. 90
Harrington, Son & Co., Edwin. 89
Link-Belt Co. 47

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
American Emery Wheel Wks. 86
Dickinson, Thos. L. 66
Greene, Tweed & Co. 85
Reed Mfg. Co. 94
Safety Emery Wheel Co. 86
Springfield Mfg. Co. 87
Standard Tool Co. 25
Vitrified Wheel Co. 87

Enamel Machinery
Felton, Sibley & Co. 110

Enclosures, Tool-Room
Hart & Cooley Co. 98

Engineers, Mechanical or Electrical
Link-Belt Co. 47
Merritt, Jos. 66
Pangborn, Thomas W. Company 117
Weeks, C. S. 125

Engines, Automobile
Doehler Die Casting Co. 121
Franklin Mfg. Co. 120

Engines, Gas and Gasolene
Automatic Machine Co. 83
Blaisdell Mchy. Co. ..116 and 124
Buckeye Engine Co. 110
Grant Mfg. & Mach. Co. 114
Palmer Bros. 110

Engines, Steam
Buckeye Engine Co. 110
Nazel Engr. & Mach. Wks. ..111

Engraving Machinery
Gorton Mach. Co., Geo. 91

Expanders, Tube
Nicholson & Co., W. H. 113
Pratt & Whitney Co. .3, 59 to 64
Watson-Stillman Co. 125

Fans, Electric
Garwood Electric Co. 101
General Electric Co. 100
Sprague Electric Co. 101
Westinghouse Elec. & Mfg. Co. 101

Fans, Exhaust
Garwood Electric Co. 101
General Electric Co. 100
Westinghouse Elec. & Mfg. Co. 101

Ferro-Vanadium
American Vanadium Co. 118

Files and Rasps
American Swiss File & Tool Co. 96
Barnett Co., G. & H. 66
Disston & Sons, Henry 48
Hammacher, Schlemmer & Co. 81
Nicholson File Co. 17
Reichhelm & Co., E. P. 96
Simonds Mfg. Co. 111

Filing Machines
American Watch Tool Co. 108
Detrick & Harvey Mach. Tool Co. 102
Grant Mfg. & Machine Co. 114
Henry & Wright Mfg. Co. 99

Filler, Iron
Felton, Sibley & Co. 110
National Tube Co. 115

Fittings, Hydraulic
Watson-Stillman Co. 125

Fittings, Steam
Walworth Mfg. Co. 66

Flanges
American Spiral Pipe Works. 124
Dart Mfg. Co., E. M. 115

Flexible Shafts
Chicago Flexible Shaft Co. ..118
Coates Clipper Mfg. Co. 128
Gem Mfg. Co. 91

Forges
Bradley & Son, C. C. 112
National Machinery Co. 128
Rockwell Furnace Co. 124

Forgings, Drop
American Spiral Pipe Works. 124
Billings & Spencer Co. 98
Bliss Co., E. W. 23
Brown & Co., R. H. 93
O. K. Tool Holder Co. 125
Page-Storms Drop Forge Co. . 91
Union Mfg. & Drop Forge Co. 123
Williams & Co., J. H. .43 and 83

Forgings, Machine
Tindel-Morris Co. 111

Forgings, Steel
American Spiral Pipe Works. 124

Forgings, Vanadium
American Vanadium Co. 124

Foundry Furnishings
Adams Co. 105
Obermayer Co., S. 124
Pangborn, Thomas W. Company 117
Paxson Co., J. W. 116
Rockwell Furnace Co. 124

Frictions, Paper and Iron
Rockwood Mfg. Co. 88

Furnaces, Annealing and Tempering
American Gas Furnace Co. ..119
Brown & Sharpe Mfg. Co., 71 and 4th cover
Chicago Flexible Shaft Co. ..118
General Electric Co. 100
Gilbert & Barker Mfg. Co. ..122
Hoskins Mfg. Co. 123
Rockwell Furnace Co. 124
Tate, Jones & Co. 122

Furnaces, Coal and Oil
Gilbert & Barker Mfg. Co. ..122
Rockwell Furnace Co. 124
Tate, Jones & Co. 122

Furnaces, Electric
General Electric Co. 100
Hoskins Mfg. Co. 123
Obermayer Co., S. 124

Furnaces, Gas
American Gas Furnace Co. ..119
Chicago Flexible Shaft Co. .. 118
Gilbert & Barker Mfg. Co. ..122
Rockwell Furnace Co. 124

Furnaces, Melting
American Gas Furnace Co. ..119
Chicago Flexible Shaft Co. ..118
Rockwell Furnace Co. 124

Furnaces, Welding
Gilbert & Barker Mfg. Co. ..118
Industrial Oxygen Co. 121
Rockwell Furnace Co. 118
Sanford Mfg. Co., F. C. 123
Toledo Electric Welder Co. ..121

Furniture, Machine Shop
Hart & Cooley Co. 98
Manufacturing Equipment & Engineering Co. 99
Page-Storms Drop Forge Co. . 91

Gages, Dial
American Watch Tool Co. ..108
Ames & Co., B. C. 108

Gages, Recording
Bristol Co. ..... 4th cover

Gages, Standard
Brown & Sharpe Mfg. Co., 71 and 4th cover
Cleveland Twist Drill Co., 4th cover
Grönkvist Drill Chuck Co. ... 93
Henry & Wright Mfg. Co. 99
Morse Twist Drill & Mach. Co. 75
Pratt & Whitney Co. .3, 59 to 64
Slocomb Co., J. T. 115
Starrett Co., L. S. 26
Wells Bros. Co. 34

Gages, Steam
Bristol Co. ..... 4th cover

Gaskets
Greene, Tweed & Co. 85
Smooth-On Mfg. Co. 122

Gear Cutting Machinery
Adams Co. 105
Becker Milling Machine Co., 23 and 120

Gear Cutting Machinery —*Continued.*
Bilgram Machine Works. 104
Brown & Sharpe Mfg. Co., 71 and 4th cover
Carpenter-Kerlin Gear & Machine Co. 105
Cincinnati Gear Cutting Machine Co. 50
Cincinnati Shaper Co. 50
Clough, R. M. 106
Fellows Gear Shaper Co. 35
Flather Mfg. Co., E. J. 106
Foote Bros. Gear & Mach. Co. 106
Gould & Eberhardt 97
Harrington, Son & Co., Edwin. 89
Marshall & Huschart Machry. Co. ..... 127 and 128
McCabe, J. J. ..... 109 and 126
Meisselbach-Catucci Mfg. Co. 106
Motch & Merryweather Co. ... 126
Newark Gear Cutting Machine Co. 106
Newton Machine Tool Wks. .. 19
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Pratt & Whitney Co. .3, 59 to 64
Prentice & Co., Geo. G. 15
Schmidt, F. L. 111
Sloan & Chace Mfg. Co. 41
Spacke Mach. Co., F. W. 117
Van Dorn & Dutton Co. 106
Walcott & Wood Mach. Tool Co. 108
Waltham Machine Works. 108
Whiton Machine Co., D. E. ... 93

Gear Testing Machinery
Gisholt Machine Co. 99
Morse Twist Drill & Mach. Co. 75

Gears, Cut
Adams Co. 105
American Vanadium Co. 118
Bilgram Machine Works. 104
Bostoa Gear Works. 104
Brown & Sharpe Mfg. Co., 71 and 4th cover
Caldwell & Sons Co., H. W. .. 90
Carpenter-Kerlin Gear & Machine Co. 105
Cincinnati Gear Co. 104
Clough, R. M. 106
Earle Gear & Machine Co. ... 105
Fawcus Machine Co. 104
Fellows Gear Shaper Co. 34
Flather Mfg. Co., E. J. 106
Foote Bros. Gear & Mach. Co. 106
Gould & Eberhardt 97
Grant Gear Works. 104
Hardinge Bros. 130
Harrington, Son & Co., Edwin. 89
Horsburgh & Scott Co. 104
Lea Equipment Co. 107
New Process Rawhide Co. ... 106
Newark Gear Cutting Machine Co. 106
Nuttall Co., R. D. 104
Philadelphia Gear Works. 104
Quride Co. 106
Sawyer Gear Works. 104
Spacke Mach. Co., F. W. 116
Taylor-Wilson Mfg. Co. 105
Van Dorn & Dutton Co. 106
Walcott & Wood Mach. Tool Co. 108

Gears, Molded
Caldwell & Sons Co., H. W. .. 90
Doehler Die Casting Co. 121
Franklin Mfg. Co. 120
Horsburgh & Scott Co. 104
Philadelphia Gear Works. 104
Taylor-Wilson Mfg. Co. 105
Van Dorn & Dutton Co. 106

Gears, Quride
Quride Co. 106

Gears, Rawhide
Boston Gear Works. 104
Earle Gear & Mach. Co. 105
Foote Bros. Gear & Mach. Co. 106
Gould & Eberhardt 97
Grant Gear Works. 104
Horsburgh & Scott Co. 104
New Process Rawhide Co. 106
Nuttall Co., R. D. 104
Philadelphia Gear Works. 104
Sawyer Gear Works. 104
Van Dorn & Dutton Co. 106

Gears, Worm
Albro-Clem Elevator Co. 106
Boston Gear Works. 104
Brown & Sharpe Mfg. Co., 71 and 4th cover
Carpenter-Kerlin Gear & Machine Co. 105
Cincinnati Gear Co. 104
Earle Gear & Machine Co. ... 105
Fawcus Machine Co. 104
Foote Bros. Gear & Mach. Co. 106
Gould & Eberhardt 97
Horsburgh & Scott Co. 104
Newark Gear Cutting Machine Co. 106
Nuttall Co., R. D. 104
Philadelphia Gear Works. 104
Quride Co. 106
Taylor-Wilson Mfg. Co. 105
Van Dorn & Dutton Co. 106

Generating Sets
Burke Electric Co. 102
Garwood Electric Co. 101
General Electric Co. 100
Roth Bros. & Co. 102
Sprague Electric Co. 101
Triumph Electric Co. 103
Westinghouse Elec. & Mfg. Co. 101

Generators, Gas
American Gas Furnace Co. ... 119

Graphite
Dixon Crucible Co., Jos. 122
Felton, Sibley & Co. 110

Grinders, Bench
Diamond Machine Co. 46
Goodell-Pratt Co. 124
Springfield Mfg. Co. 87
Webster & Perks Tool Co. 86
Walker & Co., O. S. ..... 4th cover

Grinders, Center
Coates Clipper Mfg. Co. 128
Diamond Machine Co. 46
Gem Mfg. Co. 91
Greenfield Machine Co. 87
Mueller Machine Tool Co. 113
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Trump Bros. Machine Co. 93
U. S. Electrical Tool Co. 102

Grinders, Chucking
Bryant Chucking Grinder Co. 30
Pratt & Whitney Co. .3, 59 to 64

Grinders, Cutter
Bath Grinder Co. 81
Becker Milling Machine Co., 23 and 120
Blake & Johnson Co. 87
Brown & Sharpe Mfg. Co., 71 and 4th cover
Carpenter-Kerlin Gear & Machine Co. 105
Cincinnati Milling Mach. Co. . 6 and 7
Garvin Machine Co. 129
Gould & Eberhardt 97
Greenfield Machine Co. 87
Ingersoll Milling Mach. Co. ..114
LeBlond Mach. Tool Co., R. K., 79 and 4th cover
McCabe, J. J. ..... 109 and 126
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Norton Grinding Co. 84
Oesterlein Machine Co. 129
Pratt & Whitney Co. .3, 59 to 64
Prentiss Tool & Supply Co. ..126
Rivett Lathe Mfg. Co. ..3d cover
U. S. Electrical Tool Co. 102
Wells & Son Co., F. E. 86
Wilmarth & Morman Co. 87

Grinders, Cylindrical
Bath Grinder Co. 81
Brown & Sharpe Mfg. Co., 71 and 4th cover
Greenfield Machine Co. 87
Landis Tool Co. 73
Morse Twist Drill & Mach. Co. 75
Norton Grinding Co. 84
Springfield Mfg. Co. 87

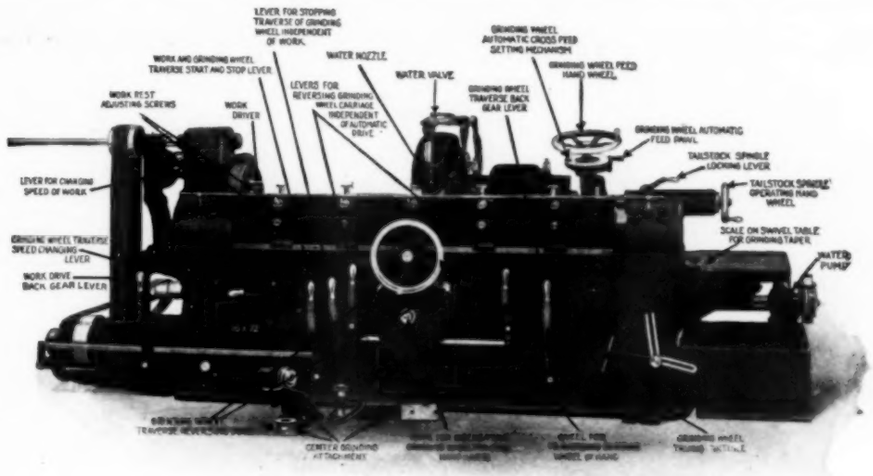
Grinders, Disc
Bath Grinder Co. 81
Besly & Co., Chas. H. 45
Diamond Machine Co. 46
Gardner Machine Co. 87
Ransom Mfg. Co. 86
Rowbottom Machine Co. 87
Safety Emery Wheel Co. 86
Taylor & Fenn Co. 115

Grinders, Drill
Morse Twist Drill & Mach. Co. 75
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Safety Emery Wheel Co. 86
Sellers & Co., Wm. 32
Standard Tool Co. 25
U. S. Electrical Tool Co. 102
Washburn Shops. 107
Wilmarth & Morman Co. 87

Grinders, Internal
American Watch Tool Co. 108
Bath Grinder Co. 81
Brown & Sharpe Mfg. Co., 71 and 4th cover
Diamond Machine Co. 46
Greenfield Machine Co. 87
Landis Tool Co. 73
Rivett Lathe Mfg. Co. ..3d cover
U. S. Electrical Tool Co. 102

Grinders, Knife
Safety Emery Wheel Co. 86
Springfield Mfg. Co. 87

Grinders, Portable
Coates Clipper Mfg. Co. 128
U. S. Electrical Tool Co. 102


LEVER FOR STOPPING TRAVERSE OF GRINDING WHEEL INDEPENDENT OF WORK.
WORK AND GRINDING WHEEL TRAVERSE START AND STOP LEVER
WATER NOZZLE
WATER VALVE
GRINDING WHEEL AUTOMATIC CROSS FEED SETTING MECHANISM
GRINDING WHEEL FEED HAND WHEEL
WORK REST ADJUSTING SCREWS
WORK DRIVER
LEVERS FOR REVERSING GRINDING WHEEL CARRIAGE INDEPENDENT OF AUTOMATIC DRIVE
GRINDING WHEEL TRAVERSE BACK GEAR LEVER
GRINDING WHEEL AUTOMATIC FEED SWING
TAILSTOCK SPINDLE LOCKING LEVER
LEVER FOR CHANGING SPEED OF WORK
TAILSTOCK SPINDLE OPERATING HAND WHEEL
SCALE ON SWIVEL TABLE FOR GRINDING TAPER
GRINDING WHEEL TRAVERSE SPEED CHANGING LEVER
WATER PUMP
WORK DRIVE BACK GEAR LEVER
CENTER GRINDING ATTACHMENT

All operating levers, handles and adjustments are within easy reach of the operator from the front of the machine. The grinding wheel is always in plain view of the operator when making speed change or adjustment.

The Art Of Grinding Is A "Found" One

There are many lost arts, but the art of **Grinding** ranks among the found ones—

For grinding, as it is today, with the Landis Grinding Machine, is an art that has turned loss into profit and cheapened manufacturing costs in all parts of the world.

Landis Grinders

It pays to grind parts that require close fitting.

Send us your drawings and let us estimate the grinding time for you, or send us samples if you are interested and we will gladly show you what can be done by the use of our grinding machines.

Write for a free copy of our Catalog "A."

Landis Tool Company

Waynesboro, Pa., U. S. A.

New York Office, Fulton Building, 50 Church Street, Walter H. Foster & Co., *Managers.*

Agents—C. W. Burton, Griffiths & Co., London and Glasgow, Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg, Copenhagen and Budapest. Alfred H. Schutte, Cologne, Brussels, Liege, Milan, Paris and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Canada.

Grinders, Saw

Tindel-Morris Co.....111

Grinders, Surface

Springfield Mfg. Co..... 87

Grinders, Tool

Armstrong Bros. Tool Co.... 97
Barnes Co., W. F. & John.... 14
Bath Grinder Co..... 81
Blake & Johnson Co..... 87
Blount Co., J. G..... 86
Brown & Sharpe Mfg. Co., 71 and 4th cover
Cincinnati Milling Mach. Co., 6 and 7
Diamond Machine Co..... 46
Gisholt Machine Co..... 99
Gould & Eberhardt..... 97
Grant Mfg. & Mach. Co.....114
Greenfield Machine Co..... 87
Landis Tool Co..... 73
LeBlond Mach. Tool Co., R. K., 79 and 4th cover
McCabe, J. J.....109 and 126
Modern Tool Co.....113
Morse Twist Drill & Mach. Co. 75
Newark Gear Cutting Machine Co.....106
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Norton Grinding Co..... 84
Oesterlein Machine Co.....129
Ransom Mfg. Co..... 86
Rivett Lathe Mfg. Co...3d cover
Rockford Drilling Mach. Co...130
Rowbottom Machine Co..... 87
Safety Emery Wheel Co..... 86
Sellers & Co., Wm..... 32
Standard Tool Co..... 25
Tabor Mfg. Co..... 28
U. S. Electrical Tool Co.....102
Vandyck Churchill Co.....128
Vitrified Wheel Co..... 87
Walker & Co., O. S.....4th cover
Webster & Perks Tool Co.... 86
Wells & Son Co., F. E..... 86
Whitney Mfg. Co..... 69
Wilmarth & Morman Co..... 87

Grinding or Polishing Machines

Abbott Ball Co..... 90
American Emery Wheel Wks. 86
Barnes Co., W. F. & John.... 14
Bath Grinder Co..... 81
Besly & Co., Chas. H..... 45
Blake & Johnson Co..... 87
Blount Co., J. G..... 86
Brown & Sharpe Mfg. Co., 71 and 4th cover
Bryant Chucking Grinder Co.. 30
Coates Clipper Mfg. Co.....128
Diamond Machine Co..... 46
Gardner Machine Co..... 87
Garvin Machine Co.....129
Greenfield Machine Co..... 87
Harrington, Son & Co., Edwin. 89
Hill, Clarke & Co...110 and 125
Landis Tool Co..... 73
McCabe, J. J.....109 and 126
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Norton Grinding Co..... 84
Ransom Mfg. Co..... 86
Rowbottom Machine Co..... 87
Rivett Lathe Mfg. Co...3d cover
Roth Bros. & Co.....102
Safety Emery Wheel Co..... 86
Springfield Mfg. Co..... 87
Sterling Emery Wheel Mfg. Co. 86
U. S. Electrical Tool Co.....102
Vitrified Wheel Co..... 87
Webster & Perks Tool Co.... 86
Wells & Son Co., F. E..... 86

Grinding Wheels

American Emery Wheel Wks. 86
Carborundum Co..... 38
Coates Clipper Mfg. Co.....128
Diamond Machine Co..... 46
Dickinson, Thos. L..... 66
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Norton Co..... 85
Safety Emery Wheel Co..... 86
Springfield Mfg. Co..... 87
Sterling Emery Wheel Mfg. Co. 86
Vitrified Wheel Co..... 87
Whitney Mfg. Co..... 69

Grindstones and Frames

Brown & Sharpe Mfg. Co., 71 and 4th cover
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Norton Co..... 85
Sterling Emery Wheel Mfg. Co. 86

Gun Barrel Machinery

Diamond Machine Co..... 46
Pratt & Whitney Co..3, 59 to 64
Reed Co., F. E..... 27

Hammers, Air

Nazel Engr. Machine Works..111

Hammers, Belt Driven

Bradley & Son, C. C.....112
Nazel Engr. Machine Works..111
Prentiss Tool & Supply Co.'..126

Hammers, Drop

Billings & Spencer Co..... 98
Bliss Co., E. W..... 23
Bradley & Son, C. C.....112
Gould & Eberhardt.....124
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Prentiss Tool & Supply Co....126

Hammers, Pneumatic

Bliss Co., E. W..... 23
Pallett Co., Thos. H.....117
Independent Pneu. Tool Co...116
Ingersoll-Rand Co.....117
Niles-Bement-Pond Co. 2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32

Hammers, Steam

Bradley & Son, C. C.....112
Buffalo Fdry. & Mach. Co.... 112
Chambersburg Engr. Co.....110
Manning, Maxwell & Moore...131
Marshall & Huschart Machry. Co. .....137 and 138
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32
Vandyck Churchill Co.....128

Handles

Osgood, J. L.....125
Western Tool & Mfg. Co.....110

Hangers, Shafting

Brown & Sharpe Mfg. Co., 71 and 4th cover
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32

Hardening and Tempering

Bridgeport Metal Treating Co.122

Heaters, Feed Water

Whitlock Coil Pipe Co.....122

Hobbing Machines, Worm

Adams Co.....105
Brown & Sharpe Mfg. Co., 71 and 4th cover
Meisselbach-Catucci Mfg. Co..106
Newark Gear Cutting Machine Co. 106
Newton Machine Tool Wks... 19
Prentice Co., Geo. G..... 15
Pratt & Whitney Co..3, 59 to 64

Hoisting and Conveying Machinery

Caldwell & Sons Co., H. W... 90
Ford Chain Block Co..... 90
Link-Belt Co..... 47
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
United Engr. & Fdry. Co.... 40
Yale & Towne Mfg. Co..... 90

Hoists, Electric

Garwood Electric Co.....101
General Electric Co.....100
Maris Bros. 88
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Northern Engineering Wks... 88
Pawling & Harnischfeger Co.. 88
Shaw Electric Crane Co..... 88
Shepard Electric Crane and Hoist Co..... 88
Sprague Electric Co.....101
Westinghouse Elec. & Mfg. Co.101
Yale & Towne Mfg. Co..... 90

Hoists, Hand

Ford Chain Block Co..... 90
Harrington, Son & Co., Edwin. 89
Moore Co., Franklin..... 90
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Yale & Towne Mfg. Co..... 90

Hoists, Pneumatic

Independent Pneu. Tool Co...116
Ingersoll-Rand Co.....117
Northern Engineering Wks... 88
Shepard Electric Crane and Hoist Co..... 88

Hones

Carborundum Co..... 38

Hose

Sprague Electric Co.....101

Igniters, Gas Engine

Doehler Die Casting Co.....121
Franklin Mfg. Co.....120

Indicators, Speed

Brown & Sharpe Mfg. Co., 71 and 4th cover
Grant Mfg. & Mach. Co.....114

Indicators, Speed—*Cont.*

Greene, Tweed & Co..... 85
Starrett Co., L. S..... 26
Veeder Mfg. Co.....115
Warner Instrument Co.....114

Indicators, Test

Brown & Sharpe Mfg. Co., 71 and 4th cover
Norton Grinding Co..... 84
Starrett Co., L. S..... 26

Injectors

Sellers & Co., Wm..... 32

Instruments, Steel Hardness Measuring

Shore Instrument & Mfg. Co..123

Iron Bar

Milton Mfg. Co..... 41

Jacks, Hydraulic

Elmes Engineering Works, Chas. F.....116
Watson-Stillman Co.....125

Jacks, Planer

Armstrong Bros. Tool Co..... 97

Jigs and Fixtures

Grant Mfg. & Machine Co....114
National Mach. & Tool Co....113
Risdon Tool Mach. Co.....110

Kettles, Soda

Brown & Sharpe Mfg. Co., 71 and 4th cover
Gray & Prior Machine Co....107
Manufacturing Equipment and Engineering Co..... 99

Key Seaters

Baker Bros. 89
Davis Machine Co., W. P..... 45
Lapointe Mach. Tool Co.....103
Marshall & Huschart Machry. Co. C.....127 and 128
Mitts & Merrill..... 91
Mcrton Manufacturing Co....124
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Rockford Drilling Mach. Co..130
Whitney Mfg. Co..... 69

Keys, Machine

Morse Twist Drill & Mach. Co. 75
Standard Gauge Steel Co.....121
Whitney Mfg. Co..... 69

Knives, Machine

Coes Wrench Co..... 31
Disston & Sons, Henry..... 48
Simonds Mfg. Co.....111

Knurl Holder

Graham Mfg. Co..... 94
Pratt & Whitney Co..3, 59 to 64

Lamps, Arc

General Electric Co.....100
Westinghouse Elec. & Mfg. Co.101

Lathe Attachments

American Tool Works Co..... 8
Bradford Mach. Tool Co..... 5
Diamond Machine Co..... 46
Fitchburg Machine Works, 108
LeBlond Mach. Tool Co., R. K., 79 and 4th cover
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Pratt & Whitney Co..3, 59 to 64
Rivett Lathe Mfg. Co...3d cover
Sebastian Lathe Co.....109
Seneca Falls Mfg. Co.....109
Sloan & Chace Mfg. Co..... 41

Lathe Dogs

American Tool & Machine Co.114
Armstrong Bros. Tool Co.... 97
Besly & Co., Chas. H..... 45
Billings & Spencer Co..... 98
Hammacher, Schlemmer & Co. 81
Pratt & Whitney Co..3, 59 to 64
Springfield Mach. Tool Co.... 65
Tindel Morris Co.....111
Western Tool & Mfg. Co.....110
Williams & Co., J. H..43 and 83

Lathes

Acme Machine Tool Co..... 38
American Tool Works Co.... 8
Automatic Machine Co..... 83
Barnes Co., W. F. & John.... 14
Barnes Drill Co..... 86
Blount Co., J. G..... 86
Bradford Mach. Tool Co..... 5
Bullard Machine Tool Co., 132 and 133
Carter & Hakes Machine Co.. 94
Champion Tool Works Co...109
Cincinnati Lathe & Tool Co..108
Davis Machine Co., W. P.... 45
Detrick & Harvey Mach. Co..102
Diamond Machine Co..... 46
Dreses Machine Tool Co..... 22
Fay Mach. Tool Co..... 42
Fay & Scott..... 66
Fitchburg Machine Works, 108
Flather Mfg. Co., E. J.....106
Garvin Machine Co.....129

Lathes—*Continued.*

Gisholt Machine Co..... 99
Greaves, Klusman & Co.....108
Hamilton Machine Tool Co... 39
Harrington, Son & Co., Edwin. 89
Hendey Machine Co..... 77
Hill, Clarke & Co...110 and 125
LeBlond Mach. Tool Co., R. K., 79 and 4th cover
Lodge & Shipley Mach. Tool Co. 4
Manning, Maxwell & Moore...131
Marshall & Huschart Machry. Co. .....137 and 138
McCabe, J. J.....109 and 126
Motch & Merryweather Mchry. Co. 126
New Haven Mfg. Co..... 40
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Pratt & Whitney Co..3, 59 to 64
Prentice Bros. Co..... 29
Prentiss Tool & Supply Co...126
Reed Co., F. E..... 27
Rockford Drilling Mach. Co..130
Schumacher & Boye..... 22
Sebastian Lathe Co.....109
Sellers & Co., Wm..... 32
Seneca Falls Mfg. Co.....109
South Bend Mach. Tool Co...108
Springfield Mach. Tool Co.... 65
Tindel Morris Co.....111
Toomey, Frank.....128
Vandyck Churchill Co.....128
Von Wyck Mach. Tool Co....108
Walcott & Wood Mach. Tool Co. 108
Wells & Son Co., F. E..... 86
Windsor Machine Co..... 16
Wormer Mchry. Co., C. C....127

Lathes, Automatic Screw Threading

Automatic Machine Co..... 83
Fay Machine Tool Co..... 42
Pratt & Whitney Co..3, 59 to 64
Prentiss Tool & Supply Co...126

Lathes, Bench

American Watch Tool Co.....108
Ames & Co., B. C.....108
Blount Co., J. G..... 86
Diamond Machine Co..... 46
Goodell-Pratt Co.....124
Hardinge Bros.....130
Pratt & Whitney Co..3, 59 to 64
Rivett Lathe Mfg. Co...3d cover
Sebastian Lathe Co.....109
Seneca Falls Mfg. Co.....109
Sloan & Chace Mfg. Co..... 41
South Bend Mach. Tool Co...108
Stark Tool Co.....103
Taylor & Fenn Co.....115
Waltham Watch Tool Co.....129
Wells & Son Co., F. E..... 86

Lathes, Boring

Harrington, Son & Co., Edwin. 89
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32

Lathes, Brass

Acme Machine Tool Co..... 36
Bardons & Oliver.....125
Dreses Mach. Tool Co..... 22
Fay & Scott..... 66
Garvin Machine Co.....129
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Pratt & Whitney Co..3, 59 to 64
Springfield Mach. Tool Co... 65
Warner & Swasey Co..... 33

Lathes, Chucking

International Mach. Tool Co.134
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127

Lathes, Extension

Barnes Drill Co..... 85
Fay & Scott..... 66
Harrington, Son & Co., Edwin. 89
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127

Lathes, Foot Power

Barnes Co., W. F. & John.... 14
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
South Bend Mach. Tool Co... 108

Lathes, Gap

American Tool Wks. Co..... 8
Barnes Drill Co..... 85
Fay & Scott..... 66
Harrington, Son & Co., Edwin. 86
Sebastian Lathe Co.....109
Sellers & Co., Wm..... 32

Lathes, Speed

Blount Co., J. G..... 86
Diamond Machine Co..... 46
Grant Mfg. & Mach. Co.....114
LeBlond Mach. Tool Co., R. K., 79 and 4th cover
Marshall & Huschart Machry. Co. .....127 and 128

MORSE TWIST DRILL AND MACHINE COMPANY

NEW BEDFORD, MASS., U. S. A.

Builders Of

Plain Grinding Machines with Automatic Feeds

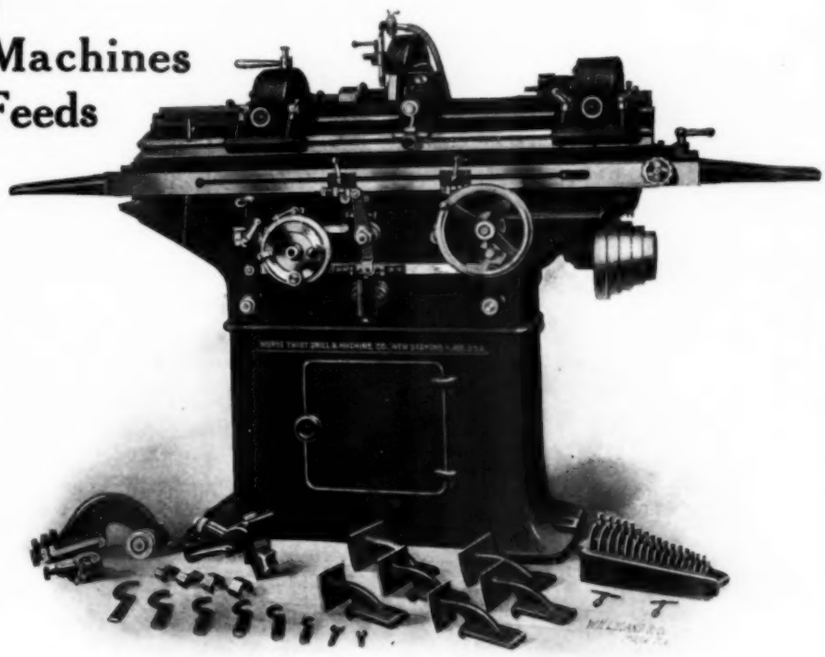
No. 1—2″ x 20″
No. 2—4″ x 30″

These Machines are durable, handy to operate and will produce accurate work.

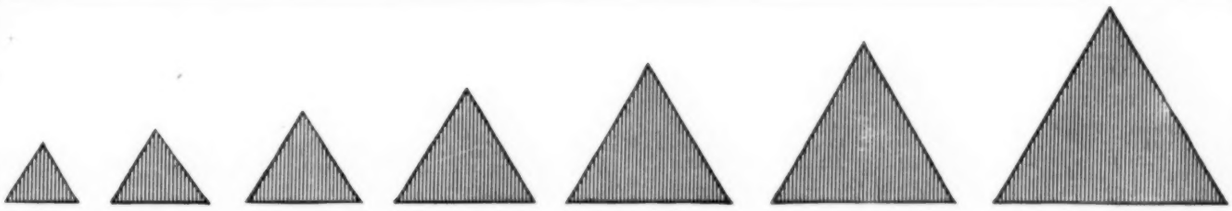
Price includes center grinding attachment, back rests, set of dogs, one 14 in. emery wheel, ¾ in. face, 7 in. hole, wrenches and everything else shown in cut, together with overhead works. Boxed and delivered F. O. B., New Bedford.

Price on application.

Send for descriptive circulars. Our 1910 Catalog sent on request.



No. 2.



We carry in stock all the triangular sizes suitable for the G. R. Lang Company's (Meadville, Pa.) Tool Holder in both

NOVO AND NOVO-SUPERIOR

High Speed Steels. The durability of these steels is three times higher than that of any other High Speed Steels. Results are guaranteed. Send us a trial order.

HERMANN BOKER & COMPANY

101-103 DUANE STREET, NEW YORK CITY

Chicago Warehouse, 217-223 North Desplaines St. **Montreal, Canada, Warehouse, 332 St. James St.**

Pacific Coast Agents—The Pacific Tool & Supply Co., San Francisco, Cal.

Lathes, Speed—*Continued.*
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Sebastian Lathe Co.....109
Seneca Falls Mfg. Co.....109
Wells & Son Co., F. E..... 86

Lathes, Turret
Fay & Scott..... 66
Foster Machine Co.....108
Gisholt Machine Co..... 99
International Mach. Tool Co.134
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Pratt & Whitney Co..3, 59 to 64
Warner & Swasey Co..... 33
Washburn Shops.....107

Lathes, Wood
Barnes Co., W. F. & John.... 14
Fay & Scott..... 66
Seneca Falls Mfg. Co.....109
South Bend Mach. Tool Co...108

Levels
Disston & Sons, Henry..... 48
Goodell-Pratt Co.....124
Keuffel & Esser Co.....103
Starrett Co., L. S..... 26

Lockers, Clothes
Hart & Cooley Co..... 98
Manufacturing Equipment and Engineering Co..... 99

Lubricants
Besly & Co., Chas. H..... 45
Dixon Crucible Co., Jos.....122

Lubricators
Besly & Co., Chas. H..... 45
Gem Mfg. Co..... 91
Greene, Tweed & Co..... 85

Machinery Dealers
Besly & Co., Chas. H..... 45
Garvin Machine Co.....129
Hill, Clarke & Co...110 and 125
Lea Equipment Co.....107
Manning, Maxwell & Moore...151
Marshall & Huschart Mchry. Co. .....127 and 128
McCabe, J. J.....109 and 126
McCabe Machine Co.....127
Motch & Merryweather Co...126
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Osgood, J. L.....125
Prentiss Tool & Supply Co...126
Toomey, Frank.....128
Vandyck Churchill Co.....128
Wormer Mchry. Co., C. C....127

Machinists' Small Tools
Bemis & Call Hardware and Tool Co.....116
Besly & Co., Chas. H..... 45
Billings & Spencer Co..... 48
Boker & Co., Hermann..48 and 75
Brown & Sharpe Mfg. Co., 71 and 4th cover
Cleveland Twist Drill Co., 4th cover
Diamond Saw & Stamping Wks.128
Goodell-Pratt Co.....124
Hammacher, Schlemmer & Co. 81
Millers Falls Co..... 96
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Poorman, J. E.....129
Pratt & Whitney Co..3, 59 to 64
Slocomb Co., J. T.....115
Standard Tool Co..... 25
Starrett Co., L. S..... 26
Whitman & Barnes Mfg. Co... 38
Williams & Co., J. H..43 and 83

Machinists' Supplies
Bemis & Call Hardware & Tool Co. 116
Besly & Co., Chas. H..... 45
Diamond Saw & Stamping Wks.128
Hammacher, Schlemmer & Co., 48 and 75
McCabe, J. J.....109 and 126
Osgood, J. L.....125
Whitman & Barnes Mfg. Co.. 38

Mandrels, Expanding
Celfor Tool Co.....114
Morse Twist Drill & Mach. Co. 75
Nicholson & Co., W. H.....113
Pratt & Whitney Co..3, 59 to 64
Western Tool & Mfg. Co.....110

Mandrels, Solid
Brown & Sharpe Mfg. Co., 71 and 4th cover
Cleveland Twist Drill Co., 4th cover
Morse Twist Drill & Mach. Co. 75
Pratt & Whitney Co..3, 59 to 64
Standard Tool Co..... 25

Measuring Machines
Pratt & Whitney Co..3, 59 to 64

Metal, Bearings
Besly & Co., Chas. H..... 45
Cluin & Atkinson.....124
Lumen Bearing Co.....124
Reeves Pulley Co..... 88

Meters, Cut
Warner Instrument Co.....114

Micrometer Calipers
Brown & Sharpe Mfg. Co., 71 and 4th cover
Slocomb Co., J. T.....115
Starrett Co., L. S..... 26

Milling Attachments
Adams Co.....105
Becker Milling Machine Co., 23 and 120
Bliss Mfg. Co., E. C.....107
Brown & Sharpe Mfg. Co., 71 and 4th cover
Cincinnati Milling Mach. Co., 6 and 7
Garvin Machine Co.....129
Ingersoll Milling Mach. Co....114
Kearney & Trecker Co..... 26
Kempsmith Mfg. Co..... 27
LeBlond Mach. Tool Co., R. K., 79 and 4th cover
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Oesterlein Machine Co.....129
Rivett Lathe Mfg. Co...3d cover
Whitney Mfg. Co..... 69

Milling Machines, Bench
American Watch Tool Co.....108
Ames & Co., B. C.....108
Carter & Hakes Machine Co.. 94
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Pratt & Whitney Co..3, 59 to 64
Rivett Lathe Mfg. Co...3d cover
Sloan & Chace Mfg. Co..... 41
Stark Tool Co.....103
Waltham Watch Tool Co.....129

Milling Machines, Hand
Adams Co.....105
Becker Milling Machine Co., 23 and 120
Brown & Sharpe Mfg. Co., 71 and 4th cover
Carter & Hakes Machine Co 94
Cincinnati Milling Mach. Co. 6 and 7
Garvin Machine Co.....129
Pratt & Whitney Co..3, 59 to 64
Prentiss Tool & Supply Co...126
Whitney Mfg. Co..... 69

Milling Machines, Horizontal
Adams Co.....105
Beaman & Smith Co..25 and 92
Becker Milling Machine Co., 23 and 120
Brown & Sharpe Mfg. Co., 71 and 4th cover
Cincinnati Milling Mach. Co., 6 and 7
Hendey Machine Co..... 77
Hess-Bright Mfg. Co..... 49
Ingersoll Milling Mach. Co...114
Kempsmith Mfg. Co..... 27
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Oesterlein Machine Co.....129
Rochester Boring Machine Co. 31
Sellers & Co., Wm..... 32

Milling Machines, Plain
Adams Co.....105
American Tool Works Co.... 8
Beaman & Smith Co..25 and 92
Becker Milling Machine Co., 23 and 120
Brown & Sharpe Mfg. Co., 71 and 4th cover
Carter & Hakes Mach. Co.... 94
Cincinnati Milling Mach. Co., 6 and 7
Garvin Machine Co.....129
Hendey Machine Co..... 77
Hill, Clarke & Co...110 and 125
Ingersoll Milling Mach. Co...114
Kearney & Trecker Co..... 26
Kempsmith Mfg. Co..... 27
LeBlond Mach. Tool Co., R. K., 79 and 4th cover
Manning, Maxwell & Moore...131
Marshall & Huschart Machry. Co. .....127 and 128
McCabe, J. J.....109 and 126
Morton Mfg. Co.....124
Motch & Merryweather Machinery Co.....126
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Oesterlein Machine Co.....129
Pratt & Whitney Co..3, 59 to 64
Vandyck Churchill Co.....128
Waltham Watch Tool Co.... 129
Warner & Swasey Co..... 33
Whitney Mfg. Co..... 69
Wormer Mchry. Co., C. C....127

Milling Machines, Portable
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Underwood & Co., H. B.....125

Milling Machines, Universal
American Tool Wks. Co..... 8
Becker Milling Machine Co., 23 and 120

Milling Machines, Universal—*Continued.*
Brown & Sharpe Mfg. Co., 71 and 4th cover
Cincinnati Milling Mach. Co., 6 and 7
Hendey Machine Co..... 77
Kearney & Trecker Co..... 26
Kempsmith Mfg. Co..... 27
LeBlond Mach. Tool Co., R. K., 79 and 4th cover
Manning, Maxwell & Moore...131
Marshall & Huschart Machine Co. .....127 and 128
McCabe, J. J.....109 and 126
Mouth & Merryweather Machinery Co.....126
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Oesterlein Machine Co.....129
Waltham Watch Tool Co.....129

Milling Machines, Vertical
Adams Co.....105
Beaman & Smith Co..25 and 92
Becker Milling Machine Co., 23 and 120
Brown & Sharpe Mfg. Co., 71 and 4th cover
Carter & Hakes Machine Co.. 94
Cincinnati Milling Mach. Co., 6 and 7
Clough, R. M.....106
Hill, Clarke & Co....110 and 125
Ingersoll Milling Mach. Co...114
Marshall & Huschart Machry. Co. .....127 and 128
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32
Vandyck Churchill Co.....128
Waltham Watch Tool Co.....129

Milling Machines, Worm
Cleveland Auto. Mach. Co.... 18
Pratt & Whitney Co..3, 59 to 64

Milling Tools, Adjustable
Geometric Tool Co..... 15

Mining Machinery
Ingersoll-Rand Co.....117

Molding Machines
Adams Co.....105
Tabor Mfg. Co..... 28
Webster & Perks Tool Co.... 86

Motors, Electric
Burke Electric Co.....102
Century Electric Co.....102
Coates Clipper Mfg. Co.....128
Cushman Elec. Co.....102
Electro Dynamic Co.....102
Garwood Electric Co.....101
General Electric Co.....100
Reliance Elec. & Eng. Co....103
Roth Bros. & Co.....102
Sprague Electric Co.....101
Triumph Electric Co.....103
Westinghouse Elec. & Mfg. Co.101

Name Plates
Franklin Mfg. Co.....129

Nippers and Pliers
Utica Drop Forge & Tool Co., 43

Nut Tappers
See Bolt and Nut Machinery.

Nuts
Milton Mfg. Co..... 41

Odometers
Veeder Mfg. Co.....115

Oil Cups and Covers
Bay State Stamping Co.....125
Besly & Co., Chas. H..... 45

Oils
Besly & Co., Chas. H..... 45
Robinson & Co., W. A.....115

Oilers
American Tube & Stamping Co.131
Gem Mfg. Co..... 91

Ovens, Enameling & Core
Cullen & Atkinson Co.....123

Oxygen, Welding
Davis-Bournonville Co.....123
Ingersoll-Rand Co.....117
Sanford Mfg. Co., F. C.....123

Packing, Smooth-On
Smooth-On Mfg. Co.....122

Packing, Steam
Greene, Tweed & Co..... 85

Paints, Machinery
Felton, Sibley & Co.....110

Pans, Lathe
New Britain Machine Co..... 91

Pans, Shop
New Britain Machine Co..... 91

Pattern Shop Tools and Machinery
Baker Bros. 89
Blount Co., J. G..... 86
Greaves, Klusman & Co.....108
Hammacher, Schlemmer & Co. 81
McCabe, J. J.....109 and 126
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Prentiss Tool & Supply Co...126
Rowbottom Machine Co..... 87
Seneca Falls Mfg. Co.....109

Patterns and Models
Schmidt, F. L.....111

Phosphor Bronze
Lumen Bearing Co... ...124

Pinion Cutters
Sloan & Chace Mfg. Co..... 41
Stark Tool Co.....103

Pipe Cutting and Threading Machines
Bignall & Keeler Mfg. Co.....110
Curtis & Curtis Co.....125
Foote-Burt Co.....102
Landis Machine Co.....123
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Saunders' Sons, D.....107
Standard Engineering Co.....106
Stoever Fdry. & Mfg. Co.....125
United Engineering & Fdry. Co. 40
Wiley & Russell Mfg. Co.....113

Pipe Fitters' Tools
Butterfield & Co.....113
Cleveland Twist Drill Co., 4th cover
Reed Mfg. Co..... 94
Saunders' Sons, D.....107
Standard Tool Co..... 25
Trimont Mfg. Co..... 96
Wells & Son Co., F. E..... 86
Williams & Co., J. H..43 and 83

Piping, High Pressure
Whitlock Coil Pipe Co.....122

Planer Attachments
Cincinnati Planer Co..... 37
Gray Co., G. A..... 28
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Reed Co., F. E..... 27

Planer Tools
Armstrong Bros. Tool Co.... 97

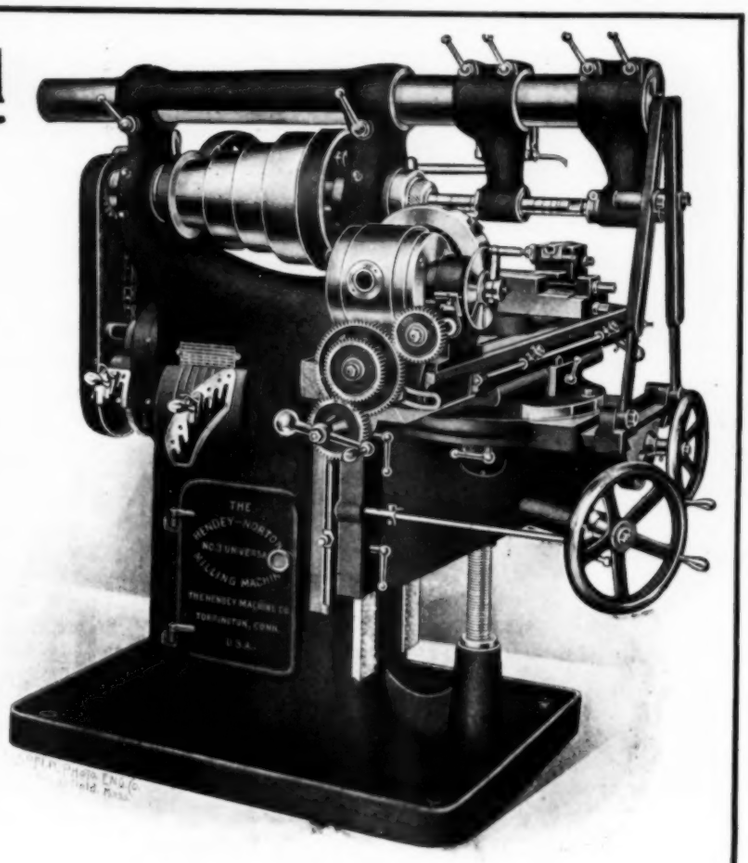
Planers
American Tool Works Co.... 8
Betts Machine Co..... 9
Cincinnati Planer Co..... 37
Cleveland Planer Works..... 98
Detrick & Harvey Mach. Co..102
Fitchburg Machine Works....108
Flather Planer Co., Mark....110
Gray Co., G. A..... 28
Hamilton Machine Tool Co... 39
Harrington, Son & Co., Edwin. 89
Hendey Machine Co..... 77
Hill, Clarke & Co...110 and 125
Manning, Maxwell & Moore...131
McCabe, J. J.....109 and 126
Motch & Merryweather Machy. Co. 126
New Haven Mfg. Co..... 40
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Pratt & Whitney Co..3, 59 to 64
Prentiss Tool & Supply Co...126
Rockford Machine Tool Co....110
Sellers & Co., Wm..... 32
Toomey, Frank.....127
Vandyck Churchill Co.....128
Woodward & Powell Planer Co. 91
Wormer Mchry. Co., C. C....127

Planers, Drive
Wheeling Mold & Fdry. Co...108

Planers, Parallel
Walker & Co., O. S.....4th cover

Planers, Portable
Morton Manufacturing Co....124
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Underwood & Co., H. B.....125

No. 3 Universal Miller



FEEDS 30x10x19″ all automatic, with positive roller chain drive. Working surface of table, 48¾″x11″. Main spindle has taper journals running in annular bearings fitted with ring oilers. Knee rigidly braced and has projected bearing on column of machine. Elevating screws telescopic. Table feed screw fitted with ball bearing thrust. Dividing head spindle travels through an arc of 216 degrees. Head has tool steel worm running in oil bath. Is tested for accuracy in divisions on an 8″ diameter plate. All feeds and reverse of same within easy control from front of knee.

A first-class miller in every particular.
Fully guaranteed.

The Hendey Machine Co.
Torrington, Conn., U. S. A.

General Agents for United States, Manning, Maxwell & Moore; C. W. Burton, Griffiths & Co., London, for Great Britain; J. E. Chabert & Co., Paris, France;

First Impressions
of our
Twist Drills

are excellent as an index of their worth. They are beautifully made and seldom fail to bring forth a word of commendation from mechanics.

In use they have proved to be fully as good as their appearance would indicate.

They are *Superior Drills* in every way and will thoroughly satisfy those who desire accurate drills of the highest quality.

Catalog mailed on request.

Union Twist Drill Company
The Cutter Makers. Athol, Mass., U. S. A.

New York Store: 54 Warren St., E. W. McKeen. Boston Agents: 25 Purchase St., E. T. Ward & Sons. Philadelphia Store: The Bourse. Chicago Store: 547 W. Washington Blvd., W. G. Lunger, Mgr.

FOREIGN AGENTS: France: Alfred H. Schutte, 22-24 Rue de Petits Hotel, Paris. England: Chas. Neat & Co., 112 Queen Victoria St., London. Agents for Sweden: Wilh. Sonesson & Co., Malmo, Stockholm and Gothenburg. Agents for Denmark, Norway and Finland: Aktieselskabet Wilh. Sonesson & Co., Copenhagen City and Freeport. Australia: Thos. McPherson & Son, Melbourne. Japan: Andrews & George, Yokohama.

Planers, Rotary
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co.,
2d cover, 51 and 58 to 127
Sellers & Co., Wm..... 32
Tindel Morris Co..... 111
Underwood & Co., H. B..... 125

Plate Rolls
Niles-Bement-Pond Co.,
2d cover, 51 and 58 to 127
Taylor-Wilson Mfg. Co.....105

Pliers
Utica Drop Forge & Tool Co.. 43

Precision Machinery
American Watch Tool Co....108
Pratt & Whitney Co..3, 59 to 64
Rivett Lathe Mfg. Co...3d cover
Sloan & Chace Mfg. Co..... 41
Stark Tool Co.....103
Waltham Watch Tool Co.....129

Presses, Arch
Blake & Johnson Co..... 87

Presses, Bench Straightening
Springfield Machine Tool Co.. 65

Presses, Broaching
Bliss Co., E. W..... 23
Consolidated Press & Tool Co.112
Prentiss Tool & Supply Co....126
Watson-Stillman Co.....125

Presses, Drop
American Tube & Stamping Co.131
Bliss Co., E. W..... 23
Consolidated Press & Tool Co.112
Niles-Bement-Pond Co.,
2d cover, 51 to 58 and 127

Presses, Foot and Hand
Bliss Co., E. W..... 23
Consolidated Press & Tool Co.112
Ferracute Machine Co.....106
Manville Mach. Co., E. J.....112
Taylor & Fenn Co.....115

Presses, Forging
Bliss Co., E. W..... 23
Consolidated Press & Tool Co.112
Niles-Bement-Pond Co.,
2d cover, 51 to 58 and 127
United Engineering & Fdry. Co. 40

Presses, Hydraulic
Elmes Eng. Wks., Chas. F....116
Niles-Bement-Pond Co.,
2d cover, 51 to 58 and 127
Prentiss Tool & Supply Co....126
Sellers & Co., Wm..... 32
United Eng. & Fdry. Co..... 40
Watson-Stillman Co.....125

Presses, Pneumatic
Springfield Machine Tool Co.. 65

Presses, Power
Automatic Machine Co..... 83
Billings & Spencer Co..... 98
Bliss Co., E. W..... 23
Consolidated Press & Tool Co.112
Dill Slotter People..... 91
Ferracute Machine Co.....106
Manville Mach. Co., E. J.....112
McCabe, J. J.....109 and 126
Niagara Machine & Tool Wks.112
Niles-Bement-Pond Co.,
2d cover, 51 to 58 and 127
Prentiss Tool & Supply Co....126
Springfield Machine Tool Co.. 65
United Engineering & Fdry. Co. 40
Vandyck Churchill Co.....128

Presses, Power Forcing
Barnes Co., W. F. & John.... 14
Lucas Machine Tool Co..... 94

Presses, Screw
Barnes Co., W. F. & John.... 14
Bliss Co., E. W..... 23
Consolidated Press & Tool Co.112

Presses, Sub
Blake & Johnson Co..... 87

Profilers
Becker Milling Machine Co.,
23 and 120
Garvin Machine Co.....129
Newton Machine Tool Wks... 19
Pratt & Whitney Co..3, 59 to 64
Stark Tool Co.....103

Publishers
McGraw-Hill Book Co.....125

Pullers
Crane Puller Co..... 90

Pulleys
American Pulley Co..... 89
American Tool & Machine Co.114
Caldwell & Sons Co., H. W... 90
Crane Puller Co..... 90
Brown & Sharpe Mfg. Co.
71 and 4th cover
Eastern Machinery Co..... 90
New Haven Mfg. Co..... 40
Niles-Bement-Pond Co.,
2d cover, 51 to 58 and 127
Oneida Steel Pulley Co..... 90

Pulleys—*Continued.*
Reeves Pulley Co..... 88
Rockwood Mfg. Co..... 88
Sellers & Co., Wm..... 32
Taylor-Wilson Mfg. Co.....105
Wilmarth & Morman Co..... 87

Pulleys, Paper
Rockwood Mfg. Co..... 88

Pulley Turning and Boring Machines
American Tool Wks. Co..... 8
Harrington, Son & Co., Edwin. 89
New Haven Mfg. Co..... 40
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co.,
2d cover, 51 to 58 and 127

Pumps, Electric
Garwood Electric Co.....101
General Electric Co.....100

Pumps, Hydraulic
Clayton Air Compressor Wks.116
Elmes Eng. Works, Chas. F...116
General Electric Co.....100
Watson-Stillman Co.....125

Pumps, Pneumatic
Ingersoll-Rand Co.....117

Pumps, Steam
Ingersoll-Rand Co.....117

Punches, Centering
Brown & Sharpe Mfg. Co.,
71 and 4th cover
Hammacher, Schlemmer & Co. 81
Sellers & Co., Wm..... 32
Starrett Co., L. S..... 26

Punches, Hand
Goodell-Pratt Co.....124
Niles-Bement-Pond Co.,
2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32

Punches, Hydraulic
Elmes Eng. Works, Chas. F...116
Niles-Bement-Pond Co.,
2d cover, 51 to 58 and 127
Prentiss Tool & Supply Co....126
Sellers & Co., Wm..... 32
United Eng. & Fdry. Co..... 40
Watson-Stillman Co.....125

Punches, Power
Armstrong-Blum Mfg. Co.....110
Bliss Co., E. W..... 23
Carpenter-Kerlin Gear & Machine Co.....105
Consolidated Press & Tool Co.112
Ferracute Machine Co.....106
Long & Allstatter Co.....112
McCabe, J. J.....109 and 126
Mitts & Merrill..... 91
Niles-Bement-Pond Co.,
2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32
United Eng. & Fdry. Co..... 40

Pyrometers, Electric
Bristol Co.....4th cover
Hoskins Mfg. Co.....123

Racks, Cut
Boston Gear Works.....104
Brown & Sharpe Mfg. Co.,
71 and 4th cover
Fellows Gear Shaper Co..... 34
Flather Mfg. Co., E. J.....106
Horsburgh & Scott Co.....104
LeBlond Mach. Tool Co., R. K.,
79 and 4th cover
Newark Gear Cutting Machine Co.....106
Nuttall Co., R. D.....104
Philadelphia Gear Works.....104
Standard Gauge Steel Co.....121
Taylor-Wilson Mfg. Co.....105
Walcott & Wood Mach. Tool Co.....108

Rack Cutting Machines
Adams Co.....105
Carpenter-Kerlin Gear & Machine Co.....105
Fellows Gear Shaper Co..... 34
Flather Mfg. Co., E. J.....106
Gould & Eberhardt..... 97
Horsburgh & Scott Co.....104
LeBlond Mach. Tool Co., R. K.,
79 and 4th cover
Niles-Bement-Pond Co.,
2d cover, 51 to 58 and 127
Reed Co., F. E..... 27
Sloan & Chace Mfg. Co..... 41
Walcott & Wood Mach. Tool Co.....108

Racks, Tool
Manufacturing Equipment and Engineering Co..... 99
New Britain Mach. Co..... 91

Radiators, Japanning Oven
American Gas Furnace Co....119

Rawhide
Colonial Leather Co.....106

Reamers
Boker & Co., Hermann..48 and 75
Butterfield & Co.....113
Card Mfg. Co., S. W..... 35
Carpenter Tap & Die Co., J. M.111
Cleveland Twist Drill Co.,
4th cover
Clough, R. M.....106
Gisholt Machine Co..... 99
Grant Nail & Supply Co.....128
Lapointe Mach. Tool Co.....103
Morse Twist Drill & Mach. Co. 75
One-Lock Reamer Co.....113
Pratt & Whitney Co..3, 59 to 64
Standard Tool Co..... 25
Ward & Son, Edgar T.....120
Western Tool & Mfg. Co.....110
Whitman & Barnes Mfg. Co.. 38
Wiley & Russell Mfg. Co.....113

Reamers, Expanding
Grant Nail & Supply Co.....128

Reaming Stands
Flather Planer Co., Mark.....110
Skinner Chuck Co..... 92

Recorders, Speed
Warner Instrument Co..... 33

Rheostats
General Electric Co.....100
Westinghouse Elec. & Mfg. Co.101

Rivet Making Machinery
Blake & Johnson Co..... 87

Riveters, Hydraulic
Niles-Bement-Pond Co.,
2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32

Riveters, Pneumatic
Bliss Co., E. W..... 23
Dallett Co., Thos. H.....117
Independent Pneu. Tool Co...116
Ingersoll-Rand Co..... 117
Niles-Bement-Pond Co.,
2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32
Shepard Electric Crane & Hoist Co..... 88

Riveters, Steam
Niles-Bement-Pond Co.,
2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32

Riveting Machines
Adt & Son, John..... 89
Grant Mfg. & Mach. Co.....114
Long & Allstatter Co.....112
National Machinery Co.....128
Niles-Bement-Pond Co.,
2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32
Shuster Co., F. B.....125
Townsend Mfg. Co., H. P.....114

Rolling Mill Machinery
Blake & Johnson Co..... 87
Niles-Bement-Pond Co.,
2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32
United Eng. & Fdry. Co..... 40

Rules, Steel
Brown & Sharpe Mfg. Co.,
71 and 4th cover
Dill Slotter People..... 91
Hammacher, Schlemmer & Co. 81
Keuffel & Esser Co.....103
Slocomb Co., J. T.....115
Starrett Co., L. S..... 26

Sand Blast Apparatus
Pangborn, Thomas W. Company.....117
Paxson Co., J. W.....116

Sand Shifting Machinery
Link-Belt Co..... 47

Saw Frames and Blades, Hack
Diamond Saw & Stamping Wks.128
Disston & Sons, Henry..... 48
Goodell-Pratt Co.....124
Hammacher, Schlemmer & Co. 81
Massachusetts Saw Works....124
Millers Falls Co..... 96
Niles-Bement-Pond Co.,
2d cover, 51 to 58 and 127
Quality Saw & Tool Wks.....111
Simonds Mfg. Co.....111
Starrett Co., L. S..... 26
West Haven Mfg. Co.....110

Sawing Machines, Metal
Diamond Saw & Stamping Wks.128
Disston & Sons, Henry..... 48
Gorton Machine Co., Geo.... 91
Hoefer Mfg. Co..... 36
Lea Equipment Co.....107
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co.,
2d cover, 51 to 58 and 127
Quality Saw & Tool Works...111

Sawing Machines, Metal—*Continued.*
Simonds Mfg. Co.....111
Tabor Mfg. Co..... 28
Tindel Morris Co.....111
Union Twist Drill Co..... 77
United Eng. & Fdry. Co..... 40
Vandyck Churchill Co.....128
West Haven Mfg. Co.....110

Sawing Machines, Wood
Greaves, Klusman & Co.....108
Seneca Falls Mfg. Co.....109

Saws, Circular Metal
Disston & Sons, Henry..... 48
Simonds Mfg. Co.....111

Saws, Metal Band
Disston & Sons, Henry..... 48
Niles-Bement-Pond Co.,
2d cover, 51 to 58 and 127
Prentiss Tool & Supply Co....126
Quality Saw & Tool Wks....111
Simonds Mfg. Co.....111
West Haven Mfg. Co.....110

Saws, Power Hack
Armstrong-Blum Mfg. Co.....110
Diamond Saw & Stamping Wks.128
Disston & Sons, Henry..... 48
Goodell-Pratt Co.....124
Millers Falls Co..... 96
Hoefer Mfg. Co..... 36
Niles-Bement-Pond Co.....
2d cover, 51 to 58 and 127
Western Tool & Mfg. Co.....110
West Haven Mfg. Co.....110

Saws, Screw Slotting
Disston & Sons, Henry..... 48
Quality Saw & Tool Wks.... 111
Simonds Mfg. Co.....111

Saw Sharpening Machines
Newton Machine Tool Wks... 19

Scales
Brown & Sharpe Mfg. Co.,
71 and 4th cover

Scleroscope
Shore Instrument & Mfg. Co..123

Schools, Technical
International Corr. School...125
Pratt Institute.....125

Scraper Holders
Western Tool & Mfg. Co.....110

Scrapers, Universal
Poorman, J. E.....129
Western Tool & Mfg. Co.....110

Screens, Shaking
Link-Belt Co..... 47

Screw Machine Work
Hampden Machine Screw Co.115
National-Acme Mfg. Co.....134
Schmidt, F. L.....111

Screw Machinery, Wood and Lag
Baker Bros. 89
Cook Co., Asa S.....110

Screw Machines, Automatic
Brown & Sharpe Mfg. Co.,
71 and 4th cover
Cleveland Automatic Mach. Co. 18
Dreses Mach. Tool Co..... 22
Marshall & Huschart Machry. Co. .....127 and 128
National-Acme Mfg. Co.....134
Pratt & Whitney Co..3, 59 to 64
Prentice & Co., Geo. G..... 15
Prentiss Tool & Supply Co...126
Windsor Machine Co..... 16
Wood Turret Machine Co....110

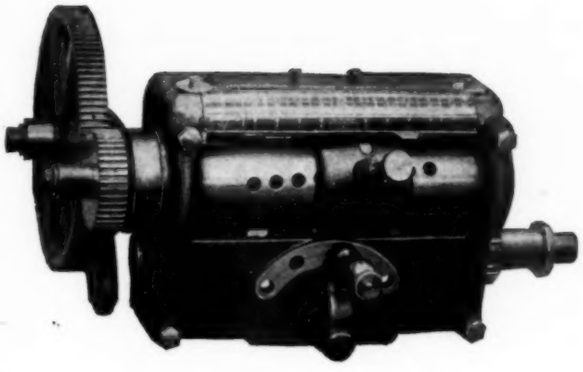
Screw Machines, Hand
Acme Machine Tool Co..... 36
Bardons & Oliver.....125
Brown & Sharpe Mfg. Co.
71 and 4th cover
Cleveland Automatic Mach. Co. 18
Foster Machine Co.....108
Garvin Machine Co.....129
Grant Mfg. & Mach. Co.....114
Jones & Lamson Mach. Co.,
12, 13 and 66
Potter & Johnston....20 and 21
Pratt & Whitney Co..3, 59 to 64
Rivett Lathe Mfg. Co....3d cover
Wells & Son Co., F. E..... 86
Warner & Swasey Co..... 33
Windsor Machine Co..... 16
Wood Turret Machine Co....110

Screw Plates
American Tap & Die Co..... 89
Besly & Co., Chas. H..... 45
Butterfield & Co.....113
Card Mfg. Co., S. W..... 35
Carpenter Tap & Die Co., J. M.111
Morse Twist Drill & Mach. Co. 75
Smart Mfg. Co., A. J.....111
Wells Bros. Co..... 34
Wiley & Russell Mfg. Co.....113

The LE BLOND Quick Change Gear

Combines

SIMPLICITY, Durability, Convenience



Simple, because:

Four shafts and nineteen gears are required for thirty-six changes.

Durable, because:

No Shafts are in torsion.

No overhanging bearings or tumblers are employed.

All Gears are made of drop forge steel.

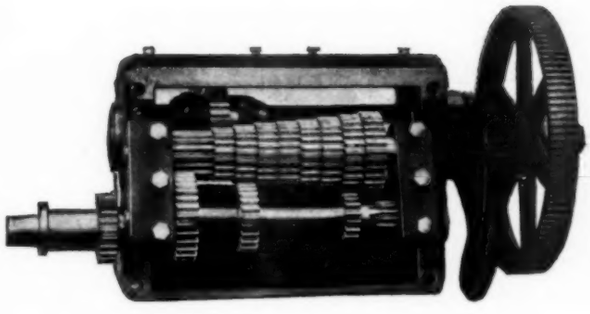
Convenient, because:

All changes are made with two operating levers placed close together.

A direct reading index plate shows the operator at a glance the correct setting of these levers for any pitch.

The end of the Lathe is open, permitting the insertion of special change Gears when required for out of the ordinary threads.

Investigate the many exclusive LeBlond features before buying.



The R. K. LeBlond Machine Tool Company

Cincinnati, Ohio.

DOMESTIC AGENTS—C. C. Wormer Mchry. Co., Detroit, Mich. J. L. Osgood, Buffalo, N. Y. The W. M. Pattison Supply Co., Cleveland, O. F. E. Satterlee Co., Minneapolis, Minn. The Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo. Portland Mchry. Co., Portland, Ore. Caldwell Bros. Co., Seattle, Wash. Smith-Booth-Usher Co., Los Angeles, Cal. Eccles & Smith Co., San Francisco, Cal. Niles-Bement-Pond Co., New York, Birmingham, Philadelphia, Boston, Pittsburg, Chicago, Hamilton, O. J. W. Wright & Co., St. Louis, Mo., Kansas City, Mo. The E. A. Kinsey Co., Cincinnati, O., Indianapolis, Ind. Thomas, S. Bowles, Norfolk, Va. Oliver H. Van Horn, New Orleans, La. Dodson Mfg. Co., Torreon, Coah., Mex. General Supply Co., S. A., Mexico, D. F., Mex. General Supply Co., Ltd., Ottawa, Can.

FOREIGN AGENTS—Ducas & Co., Austria-Hungary. Mitsui & Co., Japan. Benson Bros., Melbourne, Australia. Van Rietschoten & Houwens, Rotterdam, Holland. J. Lambercier & Co., Geneva, Switzerland. De Fries & Co., Ltd., Düsseldorf, Germany; Milan, Italy. Louis Besse, Paris, France. Henri Benedictus, Antwerp, Belgium. Hugo Tillquist, Stockholm, Sweden. S. G. Weinberg, St. Petersburg, Russia. Overall, McCray, Ltd., Sydney, Australia. Nielsen & Winther, Copenhagen, Denmark.

Screw Drivers, Machinists'
Disston & Sons, Henry..... 48

Screws, Cap and Set
Electric Welding Products Co. 124
Hammacher, Schlemmer & Co. 81
National-Acme Mfg. Co.....124
Worcester Mach. Screw Co...110

Screws, Machine
Electric Welding Products Co. 124
Hammacher, Schlemmer & Co. 81
National-Acme Mfg. Co.....134
Standard Gauge Steel Co.....121
Worcester Machine Screw Co. 110

Second Hand Machinery
Davis Machine Co., W. P..... 45
Marshall & Huschart Machry. Co. .....127 and 128
McCabe, J. J.....109 and 126
McCabe Machine Co.....127
Motch & Merryweather Machy. Co. 126
Niles-Bement-Pond Co., 2d cover, 51 to 58 a..l 127
Prentiss Tool & Supply Co....126
Seneca Falls Mfg. Co.....109
Toomey, Frank.....128
Wormer Machry. Co., C. C....127

Separators, Oil
American Tool & Machine Co. 114

Separators, Steam
Nicholson & Co., W. H.....113

Shapers
American Tool Works Co..... 8
Cincinnati Shaper Co..... 50
Davis Machine Co., W. P..... 45
Fitchburg Machine Works, 108
Flather Planer Co., Mark.....110
Gould & Eberhardt..... 97
Hamilton Mach. Tool Co..... 39
Hendey Machine Co..... 77
Hill, Clarke & Co...110 and 125
Kelly Co., R. A.....111
Manning, Maxwell & Moore...131
Marshall & Huschart Machry. Co. .....127 and 128
McCabe, J. J.....109 and 126
Morton Manufacturing Co....124
Motch & Merryweather Machinery Co.....126
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Potter & Johnston.....20 and 21
Pratt & Whitney Co..3, 59 to 64
Prentiss Tool & Supply Co....126
Queen City Mach. Tool Co...128
Rockford Machine Tool Co....110
Sellers & Co., Wm..... 32
Smith & Mills.....102
Springfield Mach. Tool Co.... 65
Vandyck Churchill Co.....128
Walcott & Wood Mach. Tool Co. 108

Shears, Hand
Goodell-Pratt Co.....124

Shears, Power
Bliss Co., E. W..... 23
Ferracute Machine Co.....106
Long & Allstatter Co.....112
Mitts & Merrill..... 91
Niagara Mach. & Tool Wks...112
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32
United Eng. & Fdry. Co..... 40
Wheeling Mold Fdry. Co.....108

Shears, Rotary
Bliss Co., E. W..... 23
Consolidated Press & Tool Co. 112
Detrick & Harvey Mach. Co..102
United Eng. & Fdry. Co..... 40

Sheet Metal Working Machinery
Bliss Co., E. W..... 23
Consolidated Press & Tool Co. 112
Ferracute Machine Co.....106
Niagara Mach. & Tool Wks...112

Slide Rests
Betts Machine Co..... 9
Blount Co., J. G..... 86
National-Acme Mfg. Co.....134
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Reed Co., F. E..... 27

Slitters
Blake & Johnson Co..... 87

Slotters
Baker Bros..... 89
Betts Machine Co..... 9
Dill Slotter People..... 91
McCabe, J. J.....109 and 126
New Haven Mfg. Co..... 40
Newton Machine Tool Wks... 19
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32
Tindel Morris Co.....111

Slotters, Auto Screw
Brown & Sharpe Mfg. Co., 71 and 4th cover
Taylor & Fenn Co.....115

Slotters, Portable
Newton Machine Tool Wks... 19

Sockets and Sleeves
Celfor Tool Co.....114
Cleveland Twist Drill Co., 4th cover
Morse Twist Drill & Mach. Co. 75
Standard Tool Co..... 25
Union Twist Drill Co..... 77

Special Machinery and Tools
Automatic Machine Co..... 83
Beaman & Smith Co..25 and 92
Bilgram Machine Works.....104
Blanchard Machine Co.....114
Bliss Co., E. W..... 23
Buffalo Fdry. & Mach. Co....112
Carter & Hakes Mach. Co.... 94
Consolidated Press & Tool Co. 112
Dallett, Thos. W.....117
Dorman, John H.....116
Earle Gear & Machine Co....105
Electric Welding Products Co. 124
Fales, L. F.....122
Foster Machine Co.....108
Garvin Machine Co.....129
Grant Mfg. & Machine Co....114
Hoefer Mfg. Co..... 36
Hoggson & Pettis Mfg. Co.... 93
Horton Machine Co., S. E.... 92
Lucas Machine Tool Co..... 94
Manning, Maxwell & Moore...131
Merritt, Jos.....66
Morrow Mfg. Co..... 93
Mueller Mach. Tool Co.....113
National Mchry. Co.....128
Nazel Engr. & Machine Wks..111
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Pratt & Whitney Co..3, 59 to 64
Risdon Tool & Mach. Co.....110
Rochester Boring Machine Co. 31
Rowbottom Machine Works.. 87
Schmidt, F. L.....111
Sloan & Chace Mfg. Co..... 41
Spacke Mach. Co., W. F.... 116
Standard Engineering Co.....106
Taylor & Fenn Co.....115
Taylor-Wilson Co.....105
Union Mfg. & Drop Forge Co. 43
Webster & Perks Tool Co.... 86

Springs
American Vanadium Co.....118

Sprocket Chains
Bilgram Machine Works.....104
Boston Gear Works.....104
Brown & Sharpe Mfg. Co. 71 and 4th cover
Link-Belt Co..... 47
Philadelphia Gear Works....104

Stampings, Sheet Metal
American Tube & Stamping Co.131
Bay State Stamping Co.....125
Bliss Mfg. Co., E. C.....107
Risdon Tool & Mach. Co.....110

Stampings, Welded
Standard Welding Co.....120

Stamps, Steel
Hoggson & Pettis Mfg. Co.... 93

Stands, Portable
Western Tool & Mfg. Co.....110

Steam Specialties
Dart Mfg. Co., E. M.....115

Steel, Air Hardening
Allen & Co., Ltd., Edgar..... 97
Boker & Co., Hermann..48 and 75
Colonial Steel Co.....124
Firth-Sterling Steel Co.....119
Vulcan Crucible Steel Co.....124

Steel, Hardness Measuring Instruments
Shore Instrument & Mfg. Co. 123

Steel, Machinery
Boker & Co., Hermann..48 and 75
Colonial Steel Co.....124
Firth-Sterling Steel Co.....119
Standard Gauge Steel Co....121
Ward & Son, Edgar T.....120

Steel, Sheet
Allen & Co., Ltd., Edgar..... 97
American Tube & Stamping Co.131
Colonial Steel Co.....124
Disston & Sons, Henry..... 48
Firth-Sterling Steel Co.....119
Simonds Mfg. Co.....111
Vulcan Crucible Steel Co.....124
Ward & Son, Edgar T.....120

Steel, Tool
American Tube & Stamping Co.131
Boker & Co., Hermann..48 and 75
Colonial Steel Co..... 124

Steel, Tool—*Continued.*
Disston & Sons, Henry..... 48
Firth-Sterling Steel Co.....119
Standard Gauge Steel Co....121
Ward & Son, Edgar T.....120
Western Tool & Mfg. Co.....110

Steel, Vanadium
American Vanadium Co.....118

Stocks, Die
See Taps and Dies.

Stones, Oil
American Emery Wheel Wks. 86
Carborundum Co..... 38
Dickinson, Thos. L..... 66
Norton Co..... 85
Vitrified Wheel Co..... 87

Stools, Shop
Manufacturing Equipment and Engineering Co..... 99
New Britain Machine Co..... 91

Straightening Machinery
Morse Twist Drill & Mach. Co. 75
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Sellers & Co., Wm..... 32
Springfield Machine Tool Co.. 65
United Eng. & Fdry. Co..... 40

Straighteners, Hydraulic
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127

Strip Metal Straightening and Cutting Machine
Shuster Co., F. B.....125

Swaging Machines
Excelsior Needle Co.....112

Switchboards
Garwood Electric Co.....101
General Electric Co.....100
Triumph Electric Co.....103
Westinghouse Elec. & Mfg. Co. 101

Switches
General Electric Co.....100
Westinghouse Elec. & Mfg. Co. 101

Tachometers
Veeder Mfg. Co.....115

Tapes, Measuring
Keuffel & Esser Co.....103
Starrett Co., L. S..... 26

Tap Holders
Brown & Sharpe Mfg. Co., 71 and 4th cover
Errington, F. A..... 93
Warner & Swasey Co..... 33

Tapping Machines and Attachments
American Tool Works Co..... 8
Baker Bros. 89
Beaman & Smith Co..25 and 92
Cincinnati Bickford Tool Co., 10 and 11
Dorman, John H.....116
Errington, F. A..... 93
Fay Mach. Tool Co..... 42
Fosdick Mach. Tool Co..... 16
Garvin Machine Co.....129
Geometric Tool Co..... 15
Gould & Eberhardt..... 97
Grant Mfg. & Mach. Co.....114
Hamilton Machine Tool Co... 39
Modern Tool Co.....113
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Pratt & Whitney Co..3, 59 to 64
Prentiss Tool & Supply Co...126
Rochester Boring Malhine Co. 31
Sloan & Chace Mfg. Co..... 41
Webster & Perks Tool Co.... 86
Wells & Son Co., F. E..... 86
Whitney Mfg. Co..... 69

Taps and Dies
American Tap & Die Co..... 89
Bay State Tap & Die Co.....103
Besly & Co., Chas. H..... 45
Boker & Co., Hermann..48 and 75
Brubaker & Bros., W. L.....110
Butterfield & Co.....113
Card Mfg. Co., S. W..... 35
Carpenter Tap & Die Co., J. M.111
Cleveland Twist Drill Co., 4th cover
Foote-Burt Co.....102
Geometric Tool Co..... 15
Hammacher, Schlemmer & Co. 81
Hardinge Bros.....130
Morse Twist Drill & Mach. Co. 75
Nicholson & Co., W. H.....113
Pratt & Whitney Co..3, 59 to 64
Reed Mfg. Co..... 94
Saunders' Sons, D.....107
Smart Mfg. Co., A. J.....111
Standard Tool Co..... 25
Ward & Sons, Edgar T.....120
Webster & Perks Tool Co.... 86
Wells Bros. Co..... 34
Wells & Son Co., F. E..... 86
Wiley & Russell Mfg. Co.....113

Taps, Collapsing
Geometric Tool Co..... 15

Testing Machines
Sellers & Co., Wm..... 32

Thermometers
Bristol Co.....4th cover

Thread Cutting Tools
Besly & Co., Chas. H..... 45
Blake & Johnson Co..... 87
Foote-Burt Co.....102
National Mchy. Co.....128
Pratt & Whitney Co..3, 59 to 64
Ready Tool Co..... 99
Rivett Lathe Mfg. Co...3d cover
United Engr. & Fdry. Co..... 40
Western Tool & Mfg. Co.....110

Thread Rolling Machinery
Manville Machine Co., E. J...112

Tool Holders
Armstrong Bros. Tool Co.... 97
Cleveland Twist Drill Co., 4th cover
Hammacher, Schlemmer & Co. 81
O. K. Tool Holder Co.....125
Osgood, J. L.....125
Pratt & Whitney Co..3, 59 to 64
Ready Tool Co..... 99
Western Tool & Mfg. Co.....110

Tool Racks
Wells & Sons Co., F. E..... 86
Western Tool & Mfg. Co.....110

Tools, Lathe
Ready Tool Co..... 99

Tools, Small
See Machinists' Small Tools.

Tracing Cloth
Keuffel & Esser Co.....103

Transformers and Converters
General Electric Co..... 100
Westinghouse Elec. & Mfg. Co. 101

Transmission Machinery
American Pulley Co..... 89
Caldwell & Sons Co., H. W... 90
Coates Clipper Mfg. Co.....128
Link-Belt Co..... 47
Morse Chain Co..... 98
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Oneida Steel Pulley Co..... 90
Reeves Pulley Co..... 88
Rockwood Mfg. Co..... 88
Sellers & Co., Wm..... 32
Smith Countershaft Co..... 90

Trolley Wheels
Lumen Bearing Co.....124

Trolleys and Tramways
Brown Hoisting Mchry. Co... 88
Harrington, Son & Co., Edwin. 89
Moore Co., Franklin..... 90
Niles-Bement-Pond Co., 2d cover, 51 to 58 and 127
Shepard Elec. Crane & Hoist Co. 88
Smith Countershaft Co..... 90
Yale & Towne Mfg. Co..... 90

Trucks
Gannett Electrical Co.....107

Tubing, Flexible
American Tube & Stamping Co.131

Tubing, Seamless Steel
Almond Mfg. Co., T. R..... 92
American Tube & Stamping Co.131
National Tube Co.....115
Standard Welding Co.....120
Ward & Son, Edgar T.....120

Turntables
Sellers & Co., Wm... 32

Turret Heads
Almond Mfg. Co., T. R..... 92

Turret Machines
Acme Machine Tool Co..... 36
American Tool & Machine Co. 114
Bardons & Oliver.....125
Bradford Mach. Tool Co..... 5
Brown & Sharpe Mfg. Co. 71 and 4th cover
Bullard Machine Tool Co., 132 and 133
Carter & Hakes Mach. Co.... 94
Davis Machine Co., W. P.... 45
Dreses Mach. Tool Co..... 22
Fay & Scott..... 66
Fay Mach. Tool Co..... 42
Flather Mfg. Co., E. J.....106
Garvin Machine Co.....129
Gisholt Machine Co..... 99
Jones & Lamson Mach. Co., 12, 13 and 66
LeBlond Mach. Tool Co., R. K., 79 and 4th cover
Lodge & Shipley Mach. Tool Co. 4